Hydrometrics, Inc.

2727 Airport Road • Helena, Montana 59601 • (406) 443-4150 • FAX (406) 443-4155

September 6, 1991

Ralph Smith
Montana Department of Health
and Environmental Sciences
Solid and Hazardous Waste Bureau
836 Front Street
Helena, MT 59601

RE: Helena Landfill Closure Plan

Dear Ralph,

Enclosed is a copy of the Helena Landfill Closure Plan submitted by the City of Helena to meet the closure requirements of the Solid and Hazardous Waste Bureau. Please review this report and call me to schedule a meeting for any questions, comments or revisions.

Sincerely,

RANDY

Randy L. Huffsmith, P. E.
Hydrologist/Engineer

RLH:jy

Enclosure

c: Dick Nisbet
Ted Hill
William Verwolf

RECEIVED
SEP 06 1991
Montana Department of Health
and Environmental Sciences
Solid and Hazardous Waste Bureau

APPENDIX A.

HELENA LANDFILL AREA WATER QUALITY

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	13	13	13	19	20	23	26	28	31	31	31	32
SAMPLE DATE	02/16/90	05/04/90	04/04/91	05/04/90	05/06/90	05/06/90	05/03/90	06/05/90	05/03/90	05/03/90	04/13/91	05/03/90
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-3298	90-10822	91-12763	90-10823	90-10825	90-10826	90-10817	90-15038	90-10820	90-10820	91-13088	90-10818
REMARKS			Helena Landfi							DUPLICATE	Helena Landfi	
SAMPLE NUMBER	HYD-5710	HYD-5711	HL9104-100	HYD-5696	HYD-5779	HYD-5747	HYD-5742	HYD-5699	HYD-5750	HYD-5751	HL9104-111	HYD-5755
-- VOLATILE ORGANICS --												
1,1,1,2-TETRACHLOROETHANE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
1,1,1-TRICHLOROETHANE (ppb)	0.78	0.79	0.88	<0.5	<0.5	1.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-TETRACHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-TRICHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-DICHLOROETHANE (ppb)	<1.0 *	<1.0 *	<1	<1	<1	1.1	<1	<1	<1	<1	<1	<1
1,1-DICHLOROETHENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50 *	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-DICHLOROPROPENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
1,2-DIBROMOETHANE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
1,2-DICHLOROETHANE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-DICHLOROPROPANE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
2,2-DICHLOROPROPANE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
2-CHLOROTOLUENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
4-CHLOROTOLUENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
BENZENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BROMOBENZENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
BROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BROMODICHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1.0 *	<1	1.9	<1.0 *	<1.0 *	<1	<1
BROMOFORM (ppb)	<1	<1	<1	<1	<1	<1	<1	<1.0 *	<1	<1	<1	<1
BROMOMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CARBON TETRACHLORIDE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CHLOROFORM (ppb)	2.9	4.4	3.6	<1	<1	7	<1	14	10	9.9	7.7	<1
CHLOROMETHANE (ppb)			<1								<1	
CIS-1,2-DICHLOROETHENE (ppb)	<1.0 *	<1.0 *		<1	<1	<1.0 *	<1	<1	<1	<1		<1
CIS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CIS-1,3-DICHLOROPROPYLENE (ppb)	1	1.9		<1	<1	4.5	<1	<1	<1	<1		<1
DIBROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1.0 *	<1	<1	<1	<1
DIBROMOMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
DICHLORODIFLUOROMETHANE (ppb)	4.3	2.3	2.4	<1	<1	6.6	<1	<1	<1	<1	<1	<1
ETHYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
XYLENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1
M-P XYLENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
O-XYLENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
METHYLENE CHLORIDE (ppb)	<1.0 *	<1	<1	<1	<1	1.1	<1	<1	<1	<1	<1	<1
STYRENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
TETRACHLOROETHENE (ppb)	2.7	2.3	3.4	<0.5	<0.5	8.1	<0.5	7.4	0.6	0.55	<0.5	<0.50
TOLUENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TRANS-1,2-DICHLOROETHENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	13	13	13	19	20	23	26	28	31	31	31	32
SAMPLE DATE	02/16/90	05/04/90	04/04/91	05/04/90	05/06/90	05/06/90	05/03/90	06/05/90	05/03/90	05/03/90	04/13/91	05/03/90
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-3298	90-10822	91-12763	90-10823	90-10825	90-10826	90-10817	90-15038	90-10820	90-10820	91-13088	90-10818
REMARKS			Helena Landfi							DUPLICATE	Helena Landfi	
SAMPLE NUMBER	HYD-5710	HYD-5711	HL9104-100	HYD-5696	HYD-5779	HYD-5747	HYD-5742	HYD-5699	HYD-5750	HYD-5751	HL9104-111	HYD-5755
-- VOLATILE ORGANICS --												
TRANS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TRICHLOROETHENE (ppb)	<0.50 *	0.74	0.5	<0.5	<0.5	1.8	<0.5	<0.50 *	<0.5	<0.5	<0.5	<0.5
TRICHLOROFLUOROMETHANE (ppb)	<1	<1.0 *	<1	<1	<1	<1.0 *	<1	<1	<1	<1	<1	<1
VINYL CHLORIDE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
-- SEMI-VOLATILE EXTRACTABLES --												
1,2,3-TRICHLOROBENZENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
1,2,3-TRICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-TRICHLOROBENZENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
1,2,4-TRIMETHYLBENZENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
1,2-DIBROMO-3-CHLOROPROPANE (ppb	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
1,2-DICHLOROBENZENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
1,3,5-TRIMETHYLBENZENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
1,3-DICHLOROBENZENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
1,3-DICHLOROPROPANE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
1,4-DICHLOROBENZENE (ppb)	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5
HEXACHLOROBUTADIENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
ISOPROPYLBENZENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
N-BUTYLBENZENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<
N-PROPYLBENZENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
NAPHTHALENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
P-ISOPROPYLTOLUENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
SEC-BUTYLBENZENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1
TERT-BUTYLBENZENE (ppb)	<1	<1		<1	<1	<1	<1	<1	<1	<1		<1

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	34	36	36	38	38	40	40	42	48	5	51	52
SAMPLE DATE	05/06/90	06/05/90	06/05/90	05/03/90	05/03/90	05/06/90	04/13/91	05/03/90	06/01/90	04/13/91	06/01/90	04/04/91
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10824	90-15040	90-15040	90-10833	90-10821	90-10831	91-13086	90-10819	90-14925	91-13087	90-14926	91-12765
REMARKS			DUPLICATE	DUPLICATE			Helena Landfi			Helena Landfi		Helena Landfi
SAMPLE NUMBER	HYD-5736	HYD-5697	HYD-5698	HYD-5745	HYD-5746	HYD-5709	HL9104-109	HYD-5739	HYD-5778	HL9104-110	HYD-5702	HL-9104-102
-- VOLATILE ORGANICS --												
1,1,1,2-TETRACHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
1,1,1-TRICHLOROETHANE (ppb)	<0.5	<0.5	<0.5	<0.50 *	<0.50 *	1.3	1	0.89	0.67	<0.5	0.54	0.6
1,1,2,2-TETRACHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-TRICHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-DICHLOROETHANE (ppb)	<1	<1	<1	<1	<1	1.5	1.2	<1.0 *	<1.0 *	<1	<1.0 *	<1
1,1-DICHLOROETHENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50 *	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
1,2-DIBROMOETHANE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
1,2-DICHLOROETHANE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-DICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
2,2-DICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
2-BUTANONE							<10					
2-CHLOROETHYL VINYL ETHER							<10					
2-CHLOROTOLUENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
2-HEXANONE							<10					
4-CHLOROTOLUENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
4-METHYL-2-PENTANONE							<10					
ACETONE							<10					
ACROLEIN							<10					
ACRYLONITRILE							<10					
BENZENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
BROMOBENZENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
BROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BROMODICHLOROMETHANE (ppb)	<1	<1	<1	<1.0 *	<1.0 *	<1.0 *	<1	<1	<1	<1	<1	<1
BROMOFORM (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BROMOMETHANE							<1					
BROMOMETHANE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1
CARBON DISULFIDE							<10					
CARBON TETRACHLORIDE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CHLOROETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CHLOROFORM (ppb)	5.6	<1	<1	7.9	9	11	11	2.8	1.6	2.3	2.3	4.3
CHLOROMETHANE							<1					
CHLOROMETHANE (ppb)										<1		<1
CIS-1,2-DICHLOROETHENE (ppb)	<1	<1	<1	<1	<1	2		<1.0 *	<1		<1	
CIS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CIS-1,3-DICHLOROPROPYLENE (ppb)	<1	<1	<1	<1.0 *	<1.0 *	4.1		2.4	<1.0 *		<1.0 *	
DIBROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
DIBROMOMETHANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

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LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10824	90-15040	90-15040	90-10833	90-10821	90-10831	91-13086	90-10819	90-14925	91-13087	90-14926	91-12765
REMARKS			DUPLICATE	DUPLICATE			Helena Landfi			Helena Landfi		Helena Landfi
SAMPLE NUMBER	HYD-5736	HYD-5697	HYD-5698	HYD-5745	HYD-5746	HYD-5709	HL9104-109	HYD-5739	HYD-5778	HL9104-110	HYD-5702	HL-9104-102
-- VOLATILE ORGANICS --												
DICHLORODIFLUOROMETHANE (ppb)	<1	<1	<1	1	<1.0 *	4.5	2.1	4.6	1	<1	1.8	3.2
ETHYL METHACRYLATE							<10					
ETHYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
ICDOMETHANE							<10					
XYLENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
M-P XYLENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
O-XYLENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
METHYLENE CHLORIDE (ppb)	<1	<1	<1	<1	<1	1	<1	<1.0 *	<1	<1	<1	<1
STYRENE							<1					
STYRENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
TETRACHLOROETHENE (ppb)	2.2	<0.5	<0.5	0.97	1.1	8	5.6	5	1.7	0.5	1.7	2.2
TOLUENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TRANS-1,2-DICHLOROETHENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TRANS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TRICHLOROETHENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	1.3	0.88	0.5	<0.50 *	<0.5	<0.50 *	<0.5
TRICHLOROFLUOROMETHANE							<1					
TRICHLOROFLUOROMETHANE (ppb)	<1	<1	<1	<1	<1	<1.0 *		<1.0 *	<1.0 *	<1	<1.0 *	<1
VINYL ACETATE							<10					
VINYL CHLORIDE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
-- SEMI-VOLATILE EXTRACTABLES --												
1,2,3-TRICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
1,2,3-TRICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-TRICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
1,2,4-TRIMETHYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
1,2-DIBROMO-3-CHLOROPROPANE (ppb	<1	<1	<1	<1	<1	<1		<1	<1		<1	
1,2-DICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
1,3,5-TRIMETHYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
1,3-DICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
1,3-DICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
1,4-DICHLOROBENZENE							<10					
1,4-DICHLOROBENZENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5		<0.5	
HEXACHLOROBUTADIENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
ISOPROPYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
N-BUTYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
N-PROPYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
NAPHTHALENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
P-ISOPROPYLTOLUENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	
SEC-BUTYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	34	36	36	38	38	40	40	42	48	5	51	52
SAMPLE DATE	05/06/90	06/05/90	06/05/90	05/03/90	05/03/90	05/06/90	04/13/91	05/03/90	06/01/90	04/13/91	06/01/90	04/04/91
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10824	90-15040	90-15040	90-10833	90-10821	90-10831	91-13086	90-10819	90-14925	91-13087	90-14926	91-12765
REMARKS			DUPLICATE	DUPLICATE			Helena Landfi			Helena Landfi		Helena Landfi
SAMPLE NUMBER	HYD-5736	HYD-5697	HYD-5698	HYD-5745	HYD-5746	HYD-5709	HL9104-109	HYD-5739	HYD-5778	HL9104-110	HYD-5702	HL-9104-102
-- SEMI-VOLATILE EXTRACTABLES --												
TERT-BUTYLBENZENE (ppb)	<1	<1	<1	<1	<1	<1		<1	<1		<1	

All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	59	59	67	67	68	82-1	82-2	82-2	82-2	82-2	82-2	82-2
SAMPLE DATE	06/01/90	04/04/91	06/01/90	06/01/90	04/04/91	12/01/82	12/01/82	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89
LAB	EL	EL	EL	EL	EL	EL	EL					
LAB NUMBER	90-14927	91-12766	90-14928	90-14929	91-12764							
REMARKS		Helena Landfi	DEEP	SHALLOW	Helena Landfi							
SAMPLE NUMBER	HYD-5701	HL9104-103	HYD-5776	HYD-5777	HL9104-101	HYD-5716	HYD-5717	HYD-5718	HYD-5719	HYD-5720	HYD-5721	HYD-5722
-- PHYSICAL PARAMETERS --												
PH						7.1	7.1					
SPEC. COND. (UMHOS/CM)						822	1160	1200		1000	1100	1100
TOTAL DISS. SOLIDS MEAS.						483	786					
TURBIDITY						760	50					
-- COMMON IONS --												
TOTAL HARDNESS AS CACO3						410	618	500	540	490	520	570
CALCIUM (CA)						90	162					
MAGNESIUM (MG)						45	52					
SODIUM (NA)						23	24					
SODIUM (NA) *TOT								29	20	24	28	38
POTASSIUM (K)						3	5					
TOTAL ALKALINITY AS CACO3						182	216					
ALKALINITY AS CACO3								210	210	180	210	200
BICARBONATE (HCO3)						221	263					
CARBONATE AS CO3						0	0					
SULFATE (SO4)						194	335					
CHLORIDE (CL)						40	34	36	35	35	37	40
-- NUTRIENTS --												
NITRATE + NITRITE AS N						11.9	35	11	6.1	18.8	6	8.7
-- TRACE ELEMENTS --												
CADMIUM (CD) *DIS						0.001	0.001					
CADMIUM (CD) *TOT								0.003	0.005	0.007	0.03	<0.002
CHROMIUM (CR) *TOT										<0.005	<0.01	<0.01
COPPER (CU) *DIS						<0.01	<0.01					
COPPER (CU) *TOT								0.04	0.01	0.02	0.03	0.03
IRON (FE) *DIS						0.88	0.14	0.19	0.17	0.41	0.04	0.04
LEAD (PB) *DIS						<0.01	<0.01					
LEAD (PB) *TOT								0.01	0.01	0.01	0.22	<0.01
MANGANESE (MN) *DIS						0.24	0.03					
MERCURY (HG) *TOT												<0.002
NICKEL (NI) *TOT								0.006	0.01	0.03	0.05	<0.01
ZINC (ZN) *DIS						<0.01	<0.01					
ZINC (ZN) *TOT								0.05	0.02	0.56	0.07	0.02
-- VOLATILE ORGANICS --												
1,1,1,2-TETRACHLOROETHANE (ppb)		<1		<1	<1							

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	59	59	67	67	68	82-1	82-2	82-2	82-2	82-2	82-2	82-2
SAMPLE DATE	06/01/90	04/04/91	06/01/90	06/01/90	04/04/91	12/01/82	12/01/82	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89
LAB	EL	EL	EL	EL	EL	EL	EL					
LAB NUMBER	90-14927	91-12766	90-14928	90-14929	91-12764							
REMARKS		Helena Landfi	DEEP	SHALLOW	Helena Landfi							
SAMPLE NUMBER	HYD-5701	HL9104-103	HYD-5776	HYD-5777	HL9104-101	HYD-5716	HYD-5717	HYD-5718	HYD-5719	HYD-5720	HYD-5721	HYD-5722
-- VOLATILE ORGANICS --												
1,1,1-TRICHLOROETHANE (ppb)	<0.50 *	<0.5	<0.5	<0.5	<0.5							
1,1,2,2-TETRACHLOROETHANE (ppb)	<1	<1	<1	<1	<1							
1,1,2-TRICHLOROETHANE (ppb)	<1	<1	<1	<1	<1							
1,1-DICHLOROETHANE (ppb)	<1.0 *	<1	<1	<1	<1							
1,1-DICHLOROETHENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5							
1,1-DICHLOROPROPENE (ppb)	<1		<1	<1								
1,2-DIBROMOETHANE (ppb)	<1		<1	<1								
1,2-DICHLOROETHANE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5							
1,2-DICHLOROPROPANE (ppb)	<1		<1	<1								
2,2-DICHLOROPROPANE (ppb)	<1		<1	<1								
2-CHLOROTOLUENE (ppb)	<1		<1	<1								
4-CHLOROTOLUENE (ppb)	<1		<1	<1								
BENZENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5							
BROMOBENZENE (ppb)	<1		<1	<1								
BROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1							
BROMODICHLOROMETHANE (ppb)	<1	<1	<1	<1	<1							
BROMOFORM (ppb)	<1	<1	<1	<1	<1							
BROMOMETHANE (ppb)	<1	<1	<1	<1	<1							
CARBON TETRACHLORIDE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5							
CHLOROBENZENE (ppb)	<1	<1	<1	<1	<1							
CHLOROETHANE (ppb)	<1	<1	<1	<1	<1							
CHLOROFORM (ppb)	1.6	1.8	<1	1.1	<1							
CHLOROMETHANE (ppb)		<1			<1							
CIS-1,2-DICHLOROETHENE (ppb)	<1		<1	<1								
CIS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1							
CIS-1,3-DICHLOROPROPYLENE (ppb)	<1.0 *		<1	<1								
DIBROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1							
DIBROMOMETHANE (ppb)	<1	<1	<1	<1	<1							
DICHLORODIFLUOROMETHANE (ppb)	1.3	2.4	<1	<1.0 *	<1							
ETHYLBENZENE (ppb)	<1	<1	<1	<1	<1							
XYLENE (ppb)	<1	<1	<1	<1	<1							
M-P XYLENE (ppb)	<1		<1	<1								
O-XYLENE (ppb)	<1		<1	<1								
METHYLENE CHLORIDE (ppb)	<1	<1	<1	<1	<1							
STYRENE (ppb)	<1		<1	<1								
TETRACHLOROETHENE (ppb)	1.1	1.3	<0.5	0.64	<0.5							
TOLUENE (ppb)	<1	<1	<1	<1	<1							

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	59	59	67	67	68	82-1	82-2	82-2	82-2	82-2	82-2	82-2
SAMPLE DATE	06/01/90	04/04/91	06/01/90	06/01/90	04/04/91	12/01/82	12/01/82	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89
LAB	EL	EL	EL	EL	EL	EL	EL					
LAB NUMBER	90-14927	91-12766	90-14928	90-14929	91-12764							
REMARKS		Helena Landfi	DEEP	SHALLOW	Helena Landfi							
SAMPLE NUMBER	HYD-5701	HL9104-103	HYD-5776	HYD-5777	HL9104-101	HYD-5716	HYD-5717	HYD-5718	HYD-5719	HYD-5720	HYD-5721	HYD-5722
-- VOLATILE ORGANICS --												
TRANS-1,2-DICHLOROETHENE (ppb)	<1	<1	<1	<1	<1							
TRANS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1							
TRICHLOROETHENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5							
TRICHLOROFLUOROMETHANE (ppb)	<1.0 *	<1	<1	<1	<1							
VINYL CHLORIDE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5							
-- SEMI-VOLATILE EXTRACTABLES --												
1,2,3-TRICHLOROBENZENE (ppb)	<1		<1	<1								
1,2,3-TRICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1							
1,2,4-TRICHLOROBENZENE (ppb)	<1		<1	<1								
1,2,4-TRIMETHYLBENZENE (ppb)	<1		<1	<1								
1,2-DIBROMO-3-CHLOROPROPANE (ppb	<1		<1	<1								
1,2-DICHLOROBENZENE (ppb)	<1		<1	<1								
1,3,5-TRIMETHYLBENZENE (ppb)	<1		<1	<1								
1,3-DICHLOROBENZENE (ppb)	<1		<1	<1								
1,3-DICHLOROPROPANE (ppb)	<1		<1	<1								
1,4-DICHLOROBENZENE (ppb)	<0.5		<0.5	<0.5								
HEXACHLOROBUTADIENE (ppb)	<1		<1	<1								
ISOPROPYLBENZENE (ppb)	<1		<1	<1								
N-BUTYLBENZENE (ppb)	<1		<1	<1								
N-NITROSO-DI-N-BUTYLAMINE (ppb)						10	18					
N-PROPYLBENZENE (ppb)	<1		<1	<1								
NAPHTHALENE (ppb)	<1		<1	<1								
P-ISOPROPYLTOLUENE (ppb)	<1		<1	<1								
SEC-BUTYLBENZENE (ppb)	<1		<1	<1								
TERT-BUTYLBENZENE (ppb)	<1		<1	<1								

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	82-3	82-3	82-3	82-3	82-3	82-3	82-3	82-4	82-4	82-4	82-4	82-4
SAMPLE DATE	12/01/82	12/01/82	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89	12/01/82	04/07/86	09/10/86	06/15/87	11/11/89
LAB	EL	EL						EL				EL
LAB NUMBER												89-20180
REMARKS		DUPLICATE										
SAMPLE NUMBER	HYD-5729	HYD-5730	HYD-5731	HYD-5732	HYD-5733	HYD-5734	HYD-5735	HYD-5763	HYD-5764	HYD-5765	HYD-5766	HYD-5767
-- PHYSICAL PARAMETERS --												
PH	6.8	6.8						7.5				
SPEC. COND. (UMHOS/CM)	1320	1320	1300		1130	1200	1140	778	820		890	
TOTAL DISS. SOLIDS MEAS.	840	848						460				
TURBIDITY	86	88						44				
-- COMMON IONS --												
TOTAL HARDNESS AS CACO3	682	696	550	620	570	530	610	379	340	380	430	
CALCIUM (CA)	175	180						103				
MAGNESIUM (MG)	60	60						30				
SODIUM (NA)	49	49						27				
SODIUM (NA) *TOT			43	42	40	46	40		31	26	28	
POTASSIUM (K)	6	6						3				
TOTAL ALKALINITY AS CACO3	496	500						222				
ALKALINITY AS CACO3			440	430	370	440	400		240	230	260	
BICARBONATE (HCO3)	605	610						271				
CARBONATE AS CO3	0	0						0				
SULFATE (SO4)	190	186						132				
CHLORIDE (CL)	44	43	38	38	36	35	41	37	32	31	33	
-- NUTRIENTS --												
NITRATE + NITRITE AS N	8.9	9.1	5.6	1.9	6	5.1	5	8.3	5.2	5	6.3	
-- TRACE ELEMENTS --												
CADMIUM (CD) *DIS	<0.001	0.001						0.002				
CADMIUM (CD) *TOT			<0.002	<0.002	<0.002	<0.005	<0.002		<0.002	0.003	<0.002	
CHROMIUM (CR) *TOT					0.008	<0.01	<0.01				0.02	
COPPER (CU) *DIS	<0.01	<0.01						<0.01				
COPPER (CU) *TOT			0.02	0.06	0.01	0.02	0.07		0.04	0.11	0.03	
IRON (FE) *DIS	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.19	
LEAD (PB) *DIS	0.01	<0.01						<0.01				
LEAD (PB) *TOT			0.007	0.01	0.006	0.07	<0.01		0.05	0.04	0.01	
MANGANESE (MN) *DIS	<0.02	<0.02						<0.02				
MERCURY (HG) *TOT							0.002					
NICKEL (NI) *TOT			<0.005	0.01	0.007	<0.01	<0.01		0.005	0.02	0.01	
ZINC (ZN) *DIS	0.01	0.02						<0.01				
ZINC (ZN) *TOT			0.02	0.01	0.01	0.04	0.06		0.04	0.14	0.04	
-- VOLATILE ORGANICS --												
1,1,1,2-TETRACHLOROETHANE (ppb)												<1

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	82-3	82-3	82-3	82-3	82-3	82-3	82-3	82-4	82-4	82-4	82-4	82-4
SAMPLE DATE	12/01/82	12/01/82	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89	12/01/82	04/07/86	09/10/86	06/15/87	11/11/89
LAB	EL	EL						EL				EL
LAB NUMBER												89-20180
REMARKS		DUPLICATE										
SAMPLE NUMBER	HYD-5729	HYD-5730	HYD-5731	HYD-5732	HYD-5733	HYD-5734	HYD-5735	HYD-5763	HYD-5764	HYD-5765	HYD-5766	HYD-5767
-- VOLATILE ORGANICS --												
1,1,1-TRICHLOROETHANE (ppb)												9.8
1,1,2,2-TETRACHLOROETHANE (ppb)												<1
1,1,2-TRICHLOROETHANE (ppb)												<1
1,1-DICHLOROETHANE (ppb)												2.4
1,1-DICHLOROETHENE (ppb)												<0.50 *
1,1-DICHLOROPROPENE (ppb)												<1
1,2-DIBROMOETHANE (ppb)												<1
1,2-DICHLOROETHANE (ppb)												<0.5
1,2-DICHLOROPROPANE (ppb)												<1
2,2-DICHLOROPROPANE (ppb)												<1
2-CHLOROTOLUENE (ppb)												<1
4-CHLOROTOLUENE (ppb)												<1
BENZENE (ppb)												<0.5
BROMOBENZENE (ppb)												<1
BROMOCHLOROMETHANE (ppb)												<1
BROMODICHLOROMETHANE (ppb)												<1
BROMOFORM (ppb)												<1
BROMOMETHANE (ppb)												<1
CARBON TETRACHLORIDE (ppb)												<0.5
CHLOROBENZENE (ppb)												<1
CHLOROETHANE (ppb)												<1
CHLOROFORM (ppb)												<1.0 *
CIS-1,2-DICHLOROETHENE (ppb)												<1.0 *
CIS-1,3-DICHLOROPROPENE (ppb)												<1
CIS-1,3-DICHLOROPROPYLENE (ppb)												33
DIBROMOCHLOROMETHANE (ppb)												<1
DIBROMOMETHANE (ppb)												<1
DICHLORODIFLUOROMETHANE (ppb)												67
ETHYLBENZENE (ppb)												<1
XYLENE (ppb)												<1
M-P XYLENE (ppb)												<1
O-XYLENE (ppb)												<1
METHYLENE CHLORIDE (ppb)												7.5
STYRENE (ppb)												<1
TETRACHLOROETHENE (ppb)												4.8
TOLUENE (ppb)												<1
TRANS-1,2-DICHLOROETHENE (ppb)												<1

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	82-3	82-3	82-3	82-3	82-3	82-3	82-3	82-4	82-4	82-4	82-4	82-4
SAMPLE DATE	12/01/82	12/01/82	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89	12/01/82	04/07/86	09/10/86	06/15/87	11/11/89
LAB	EL	EL						EL				EL
LAB NUMBER												89-20180
REMARKS		DUPLICATE										
SAMPLE NUMBER	HYD-5729	HYD-5730	HYD-5731	HYD-5732	HYD-5733	HYD-5734	HYD-5735	HYD-5763	HYD-5764	HYD-5765	HYD-5766	HYD-5767
-- VOLATILE ORGANICS --												
TRANS-1,3-DICHLOROPROPENE (ppb)												<1
TRICHLOROETHENE (ppb)												2.9
TRICHLOROFLUOROMETHANE (ppb)												40
VINYL CHLORIDE (ppb)												<0.5
-- SEMI-VOLATILE EXTRACTABLES --												
1,2,3-TRICHLOROBENZENE (ppb)												<1
1,2,3-TRICHLOROPROPANE (ppb)												<1
1,2,4-TRICHLOROBENZENE (ppb)												<1
1,2,4-TRIMETHYLBENZENE (ppb)												<1
1,2-DIBROMO-3-CHLOROPROPANE (ppb												<1
1,2-DICHLOROBENZENE (ppb)												<1
1,3,5-TRIMETHYLBENZENE (ppb)												<1
1,3-DICHLOROBENZENE (ppb)												<1
1,3-DICHLOROPROPANE (ppb)												<1
1,4-DICHLOROBENZENE (ppb)												<0.5
HEXACHLOROBUTADIENE (ppb)												<1
ISOPROPYLBENZENE (ppb)												<1
N-BUTYLBENZENE (ppb)												<1
N-NITROSO-DI-N-BUTYLAMINE (ppb)	14	14						13				
N-PROPYLBENZENE (ppb)												<1
NAPHTHALENE (ppb)												<1
P-ISOPROPYLTOLUENE (ppb)												<1
SEC-BUTYLBENZENE (ppb)												<1
TERT-BUTYLBENZENE (ppb)												<1

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	82-4	83-5	83-5	83-5	83-5	83-6	83-6	83-6	83-6	83-6	83-6	83-7
SAMPLE DATE	05/11/90	04/07/86	09/10/86	10/20/88	05/25/89	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89	04/05/91	04/07/86
LAB	EL										EL	
LAB NUMBER	90-12199										91-12769	
REMARKS											Helena Landfi	
SAMPLE NUMBER	HYD-5768	HYD-5723	HYD-5724	HYD-5725	HYD-5726	HYD-5704	HYD-5705	HYD-5706	HYD-5707	HYD-5708	HL9104-106	HYD-5712
-- PHYSICAL PARAMETERS --												
PH (pH units)											7.5	
SPEC. COND. (UMHOS/CM)		1100		980	840	910		850	780	770		2300
TDS MEAS. @ 180 DEG. C											511	
-- COMMON IONS --												
TOTAL HARDNESS AS CACO3		490	510	460	440	390	530	700	340	390		1100
CALCIUM (CA) *DIS											114	
MAGNESIUM (MG) *DIS											31	
SODIUM (NA) *DIS											23	
SODIUM (NA) *TOT		28	20	26	23	24	17	20	23	22		83
POTASSIUM (K) *DIS											5	
TOTAL ALKALINITY AS CACO3											255	
ALKALINITY AS CACO3		290	290	340	250	220	210	220	230	240		490
BICARBONATE (HCO3)											311	
CARBONATE AS CO3											0	
SULFATE (SO4)											109	
CHLORIDE (CL)		39	32	45	25	34	44	30	41	39	32	190
-- NUTRIENTS --												
NITRATE + NITRITE AS N		1.1	0.25	0.13	0.55	7.6	0.46	8	2.1	0.6	8.91	<0.1
NITROGEN AS N											<0.1	
-- TRACE ELEMENTS --												
ARSENIC (AS)											<0.005	
ARSENIC (AS) *DIS											<0.005	
BARIUM (BA) *DIS											<0.1	
CADMIUM (CD) *DIS											<0.001	
CADMIUM (CD) *TOT		0.006	<0.002	0.04	<0.002	<0.002	<0.002	0.003	<0.005	<0.002		0.008
CHROMIUM (CR) *DIS											<0.02	
CHROMIUM (CR) *TOT				<0.01	<0.01			0.04	<0.01	<0.01		
COPPER (CU) *TOT		0.07	0.03	0.02	0.02	0.06	0.05	0.11	0.03	0.02		0.17
IRON (FE) *DIS		<0.03	<0.03	0.04	<0.03	<0.03	<0.03	0.03	<0.03	<0.03	<0.03	3.5
LEAD (PB) *DIS											<0.01	
LEAD (PB) *TOT		0.01	0.01	0.01	<0.01	0.01	0.03	0.07	0.03	<0.01		0.05
MANGANESE (MN) *DIS											0.04	
MERCURY (HG) *DIS											<0.001	
MERCURY (HG) *TOT					<0.002					<0.002		

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	82-4	83-5	83-5	83-5	83-5	83-6	83-6	83-6	83-6	83-6	83-6	83-7
SAMPLE DATE	05/11/90	04/07/86	09/10/86	10/20/88	05/25/89	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89	04/05/91	04/07/86
LAB	EL										EL	
LAB NUMBER	90-12199										91-12769	
REMARKS											Helena Landfi	
SAMPLE NUMBER	HYD-5768	HYD-5723	HYD-5724	HYD-5725	HYD-5726	HYD-5704	HYD-5705	HYD-5706	HYD-5707	HYD-5708	HL9104-106	HYD-5712
-- TRACE ELEMENTS --												
NICKEL (NI) *TOT		0.008	0.01	0.09	<0.01	0.008	0.04	0.07	0.08	<0.01		0.12
SELENIUM (SE) *DIS											<0.005	
SILVER (AG) *DIS											<0.005	
ZINC (ZN) *TOT		0.06	0.07	0.083	0.02	0.05	0.08	0.13	<0.005	0.03		0.26
-- VOLATILE ORGANICS --												
1,1,1-TRICHLOROETHANE (ppb)											2.9	
1,1,2,2-TETRACHLOROETHANE (ppb)											<1	
1,1,2-TRICHLOROETHANE (ppb)											<1	
1,1-DICHLOROETHANE (ppb)											<1	
1,1-DICHLOROETHENE (ppb)											<0.5	
1,2-DICHLOROETHANE (ppb)											<0.5	
BENZENE (ppb)											<0.5	
BROMOCHLOROMETHANE (ppb)											<1	
BROMODICHLOROMETHANE (ppb)											<1	
BROMOFORM (ppb)											<1	
BROMOMETHANE (ppb)											<1	
CARBON TETRACHLORIDE (ppb)											<0.5	
CHLOROBENZENE (ppb)											<1	
CHLOROETHANE (ppb)											<1	
CHLOROFORM (ppb)											3.2	
CHLOROMETHANE (ppb)											<1	
CIS-1,3-DICHLOROPROPENE (ppb)											<1	
DIBROMOCHLOROMETHANE (ppb)											<1	
DIBROMOMETHANE (ppb)											<1	
DICHLORODIFLUOROMETHANE (ppb)											<1	
ETHYLBENZENE (ppb)											<1	
XYLENE (ppb)											<1	
METHYLENE CHLORIDE (ppb)											<1	
TETRACHLOROETHENE (ppb)											<0.5	
TOLUENE (ppb)											<1	
TRANS-1,2-DICHLOROETHENE (ppb)											<1	
TRANS-1,3-DICHLOROPROPENE (ppb)											<1	
TRICHLOROETHENE (ppb)											<0.5	
TRICHLOROFLUOROMETHANE (ppb)											<1	
VINYL CHLORIDE (ppb)											<0.5	
-- SEMI-VOLATILE EXTRACTABLES --												
1,2,3-TRICHLOROPROPANE (ppb)											<1	

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	82-4	83-5	83-5	83-5	83-5	83-6	83-6	83-6	83-6	83-6	83-6	83-7
SAMPLE DATE	05/11/90	04/07/86	09/10/86	10/20/88	05/25/89	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89	04/05/91	04/07/86
LAB	EL										EL	
LAB NUMBER	90-12199										91-12769	
REMARKS											Helena Landfi	
SAMPLE NUMBER	HYD-5768	HYD-5723	HYD-5724	HYD-5725	HYD-5726	HYD-5704	HYD-5705	HYD-5706	HYD-5707	HYD-5708	HL9104-106	HYD-5712
-- SEMI-VOLATILE EXTRACTABLES --												
1,2,4-TRICHLOROBENZENE (ppb)	<10											
1,2-DICHLOROBENZENE (ppb)	<10											
1,3-DICHLOROBENZENE (ppb)	<10											
1,4-DICHLOROBENZENE (ppb)	<10											
2-METHYL-4 6-DINITROPHENO (ppb)	<50											
2,4,6-TRICHLOROPHENOL (ppb)	<10											
2,4-DICHLOROPHENOL (ppb)	<10											
2,4-DIMETHYLPHENOL (ppb)	<10											
2,4-DINITROPHENOL (ppb)	<50											
2,4-DINITROTOLUENE (ppb)	<10											
2,6-DINITROTOLUENE (ppb)	<10											
2-CHLORONAPHTHALENE (ppb)	<10											
2-CHLOROPHENOL (ppb)	<10											
2-NITROPHENOL (ppb)	<10											
3,3-DICHLOROBENZIDINE (ppb)	<10											
4-BROMOPHENYL PHENYL ETHER (ppb)	<10											
4-CHLORO-3-METHYLPHENOL (ppb)	<10											
4-CHLOROPHENYL PHENYL ETHER (ppb	<10											
4-NITROPHENOL (ppb)	<50											
ACENAPHTHENE (ppb)	<10											
ACENAPHTHYLENE (ppb)	<10											
ANTHRACENE (ppb)	<10											
AZOBENZENE (1,2-DIPHENYLHYDRAZIN	<10											
BENZIDINE (ppb)	<10											
BENZO (A) ANTHRACENE (ppb)	<10											
BENZO (A) PYRENE (ppb)	<10											
BENZO (B) FLUORANTHENE (ppb)	<10											
BENZO (GHI) PERYLENE (ppb)	<10											
BENZO (K) FLUORANTHENE (ppb)	<10											
BIS (2-CHLOROETHOXY) METHANE (pp	<10											
BIS (2-CHLOROETHYL) ETHER (ppb)	<10											
BIS (2-CHLOROISOPROPYL) ETHER (p	<10											
BIS (2-ETHYLHEXYL) PHTHALATE (pp	<10											
BUTYL BENZYL PHTHALATE (ppb)	<10											
CHRYSENE (ppb)	<10											
DI-N-BUTYLPHTHALATE (ppb)	<10											
DI-N-OCTYL PHTHALATE (ppb)	<10											

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	82-4	83-5	83-5	83-5	83-5	83-6	83-6	83-6	83-6	83-6	83-6	83-7
SAMPLE DATE	05/11/90	04/07/86	09/10/86	10/20/88	05/25/89	04/07/86	09/10/86	06/15/87	10/20/88	05/25/89	04/05/91	04/07/86
LAB	EL										EL	
LAB NUMBER	90-12199										91-12769	
REMARKS											Helena Landfi	
SAMPLE NUMBER	HYD-5768	HYD-5723	HYD-5724	HYD-5725	HYD-5726	HYD-5704	HYD-5705	HYD-5706	HYD-5707	HYD-5708	HL9104-106	HYD-5712
-- SEMI-VOLATILE EXTRACTABLES --												
DIBENZO (A,H) ANTHRACENE (ppb)	<10											
DIETHYLPHTHALATE (ppb)	<10											
DIMETHYLPHTHALATE (ppb)	<10											
FLUORANTHENE (ppb)	<10											
FLUORENE (ppb)	<10											
HEXACHLOROBENZENE (ppb)	<10											
HEXACHLOROBUTADIENE (ppb)	<10											
HEXACHLOROETHANE (ppb)	<10											
INDENO (1,2,3-CD) PYRENE (ppb)	<10											
ISOPHORONE (ppb)	<10											
N-NITROSO-DI-N-PROPYLAMINE (ppb)	<10											
N-NITROSOPHENYLAMINE (ppb)	<10											
NAPHTHALENE (ppb)	<10											
NITROBENZENE (ppb)	<10											
PENTACHLOROPHENOL (ppb)	<50											
PHENANTHRENE (ppb)	<10											
PHENOL (ppb)	<10											
PYRENE (ppb)	<10											
-- HYDROCARBONS --												
ORGANIC CARBON (TOTAL)											<2	
-- OTHER PARAMETERS --												
CYANIDE (CN)											<0.005	
CHEMICAL OXEGEN DEMAND											<1	

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	83-7	83-7	83-7	84	9	BLANK	BLANK	EPA-1	HL-1	HL-1	HL-1	HL-1
SAMPLE DATE	09/10/86	06/15/87	10/20/88	06/06/90	06/06/90	05/07/90	11/11/90	04/05/91	09/09/80	09/10/80	06/30/82	04/07/86
LAB				EL	EL	EL	EL	EL				
LAB NUMBER				90-15044	90-15042	90-10832	89-20184	91-12768				
REMARKS								Helena Landfi				
SAMPLE NUMBER	HYD-5713	HYD-5714	HYD-5715	HYD-5703	HYD-5700	HYD-5769	HYD-5770	HL9104-105	HYD-5797	HYD-5798	HYD-5799	HYD-5800
-- PHYSICAL PARAMETERS --												
PH									6	7	7.7	
PH (pH units)												
SPEC. COND. (UMHOS/CM)		2040	4500						840	900	1360	
TDS MEAS. @ 180 DEG. C												
TOTAL DISS. SOLIDS MEAS.									623	738		
TURBIDITY											1700	
-- COMMON IONS --												
TOTAL HARDNESS AS CACO3	1200	1000	2600									950
CALCIUM (CA)											99	
CALCIUM (CA) *DIS												
MAGNESIUM (MG)											27	
MAGNESIUM (MG) *DIS												
SODIUM (NA)									32	27	71	
SODIUM (NA) *DIS												
SODIUM (NA) *TOT	65	57	210									64
POTASSIUM (K)									9	8	9	
POTASSIUM (K) *DIS												
TOTAL ALKALINITY AS CACO3												
ALKALINITY AS CACO3	480	450	810						229	272		
BICARBONATE (HCO3)											201	
CARBONATE AS CO3											0	
SULFATE (SO4)									218	227	270	
CHLORIDE (CL)	190	190	180								40	
-- NUTRIENTS --												
NITRATE (NO3-N)									4.45	4.74	18	
NITRATE + NITRITE AS N	0.13	0.05	<0.01									7.6
NITROGEN AS N												
-- TRACE ELEMENTS --												
ARSENIC (AS) *DIS								<0.005				
BARIUM (BA) *DIS								<0.1				
CADMIUM (CD) *DIS								<0.001	0.0029	0.005		
CADMIUM (CD) *TOT	0.003	0.02	0.1									0.014
CHROMIUM (CR) *DIS								<0.02	0.017	0.014		
CHROMIUM (CR) *TOT		0.04	<0.01									

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	83-7	83-7	83-7	84	9	BLANK	BLANK	EPA-1	HL-1	HL-1	HL-1	HL-1
SAMPLE DATE	09/10/86	06/15/87	10/20/88	06/06/90	06/06/90	05/07/90	11/11/90	04/05/91	09/09/80	09/10/80	06/30/82	04/07/86
LAB				EL	EL	EL	EL	EL				
LAB NUMBER				90-15044	90-15042	90-10832	89-20184	91-12768				
REMARKS								Helena Landfi				
SAMPLE NUMBER	HYD-5713	HYD-5714	HYD-5715	HYD-5703	HYD-5700	HYD-5769	HYD-5770	HL9104-105	HYD-5797	HYD-5798	HYD-5799	HYD-5800
-- TRACE ELEMENTS --												
COPPER (CU) *DIS									0.049	0.013		
COPPER (CU) *TOT	0.26	0.15	0.06									0.37
IRON (FE) *DIS	0.19	2.5	0.64								0.07	0.11
LEAD (PB) *DIS									0.011	0.14	<0.01	
LEAD (PB) *TOT	0.16	0.06	0.03									0.33
NICKEL (NI) *DIS									0.0066	0.0069		
NICKEL (NI) *TOT	0.2	0.2	0.06									0.14
ZINC (ZN) *DIS									0.74	0.45		
ZINC (ZN) *TOT	0.3	0.18	0.13									1.2
-- VOLATILE ORGANICS --												
1,1,1,2-TETRACHLOROETHANE (ppb)				<1	<1	<1	<1					
1,1,1-TRICHLOROETHANE (ppb)				<0.5	<0.5	<0.5	<0.5	<0.5				
1,1,2,2-TETRACHLOROETHANE (ppb)				<1	<1	<1	<1	<1				
1,1,2-TRICHLOROETHANE (ppb)				<1	<1	<1	<1	<1				
1,1-DICHLOROETHANE (ppb)				<1	<1	<1	<1	3.8				
1,1-DICHLOROETHENE (ppb)				<0.5	<1	<0.5	<0.5	<0.5				
1,1-DICHLOROPROPENE (ppb)				<1	<1	<1	<1					
1,2-DIBROMOETHANE (ppb)				<1		<1	<1					
1,2-DICHLOROETHANE (ppb)				<0.5	<0.5	<0.5	<0.5	<0.5				
1,2-DICHLOROPROPANE (ppb)				<1	<1	<1	<1					
2,2-DICHLOROPROPANE (ppb)				<1	<1	<1	<1					
2-CHLOROTOLUENE (ppb)				<1	<1	<1	<1					
4-CHLOROTOLUENE (ppb)				<1	<1	<1	<1					
BENZENE (ppb)				<0.5	<0.5	<0.5	0.73	<0.5				
BROMOBENZENE (ppb)				<1	<1	<1	<1					
BROMOCHLOROMETHANE (ppb)				<1	<1	<1	<1	<1				
BROMODICHLOROMETHANE (ppb)				<1	<1	<1	<1	<1				
BROMOFORM (ppb)				<1	<1	<1	<1	<1				
BROMOMETHANE (ppb)				<1	<1	<1	<1	<1				
CARBON TETRACHLORIDE (ppb)				<0.5	<0.5	<0.5	<0.5	<0.5				
CHLOROBENZENE (ppb)				<1	<1	<1	<1	<1				
CHLOROETHANE (ppb)				<1	<1	<1	<1	<1				
CHLOROFORM (ppb)				<1	<1	<1	<1	7				
CHLOROMETHANE (ppb)								<1				
CIS-1,2-DICHLOROETHENE (ppb)				<1	<1	<1	<1					
CIS-1,3-DICHLOROPROPENE (ppb)				<1	<1	<1	<1	<1				

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	83-7	83-7	83-7	84	9	BLANK	BLANK	EPA-1	HL-1	HL-1	HL-1	HL-1
SAMPLE DATE	09/10/86	06/15/87	10/20/88	06/06/90	06/06/90	05/07/90	11/11/90	04/05/91	09/09/80	09/10/80	06/30/82	04/07/86
LAB				EL	EL	EL	EL	EL				
LAB NUMBER				90-15044	90-15042	90-10832	89-20184	91-12768				
REMARKS								Helena Landfi				
SAMPLE NUMBER	HYD-5713	HYD-5714	HYD-5715	HYD-5703	HYD-5700	HYD-5769	HYD-5770	HL9104-105	HYD-5797	HYD-5798	HYD-5799	HYD-5800
-- VOLATILE ORGANICS --												
CIS-1,3-DICHLOROPROPYLENE (ppb)				<1	<1	<1						
DIBROMOCHLOROMETHANE (ppb)				<1	<1	<1	<1	<1				
DIBROMOMETHANE (ppb)				<1	<1	<1	<1	<1				
DICHLORODIFLUOROMETHANE (ppb)				<1	<1	<1	<1	11				
ETHYLBENZENE (ppb)				<1	<1	<1	<1	<1				
XYLENE (ppb)				<1	<1	<1	<1	<1				
M-P XYLENE (ppb)				<1	<1	<1	<1					
O-XYLENE (ppb)				<1	<1	<1	<1					
METHYLENE CHLORIDE (ppb)				<1	<1	<1	<1	4.2				
STYRENE (ppb)				<1	<1	<1	<1					
TETRACHLOROETHENE (ppb)				<0.5	<0.5	<0.5	<0.5	66				
TOLUENE (ppb)				<1	<1	<1	1	<1				
TRANS-1,2-DICHLOROETHENE (ppb)				<1	<1	<1	<1	<1				
TRANS-1,3-DICHLOROPROPENE (ppb)				<1	<1	<1	<1	<1				
TRICHLOROETHENE (ppb)				<0.5	<0.5	<0.5	<0.5	7.4				
TRICHLOROFLUOROMETHANE (ppb)				<1	<1	<1	<1	4.3				
VINYL CHLORIDE (ppb)				<0.5	<0.5	<0.5	<0.5	<0.5				
-- SEMI-VOLATILE EXTRACTABLES --												
1,2,3-TRICHLOROBENZENE (ppb)				<1	<1	<1	<1					
1,2,3-TRICHLOROPROPANE (ppb)				<1	<1	<1	<1	<1				
1,2,4-TRICHLOROBENZENE (ppb)				<1	<1	<1	<1					
1,2,4-TRIMETHYLBENZENE (ppb)				<1	<1	<1	<1					
1,2-DIBROMO-3-CHLOROPROPANE (ppb				<1	<1	<1	<1					
1,2-DICHLOROBENZENE (ppb)				<1	<1	<1	<1					
1,3,5-TRIMETHYLBENZENE (ppb)				<1	<1	<1	<1					
1,3-DICHLOROBENZENE (ppb)				<1	<1	<1	<1					
1,3-DICHLOROPROPANE (ppb)				<1	<1	<1	<1					
1,4-DICHLOROBENZENE (ppb)				<0.5	<0.5	<0.5	<0.5					
HEXACHLOROBUTADIENE (ppb)				<1	<1	<1	<1					
ISOPROPYLBENZENE (ppb)				<1	<1	<1	<1					
N-BUTYLBENZENE (ppb)				<1	<1	<1	<1					
N-NITROSO-DI-N-BUTYLAMINE (ppb)									163	456	89	
N-PROPYLBENZENE (ppb)				<1	<1	<1	<1					
NAPHTHALENE (ppb)				<1	<1	<1	<1					
P-ISOPROPYLTOLUENE (ppb)				<1	<1	<1	<1					
SEC-BUTYLBENZENE (ppb)				<1	<1	<1	<1					

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	83-7	83-7	83-7	84	9	BLANK	BLANK	EPA-1	HL-1	HL-1	HL-1	HL-1
SAMPLE DATE	09/10/86	06/15/87	10/20/88	06/06/90	06/06/90	05/07/90	11/11/90	04/05/91	09/09/80	09/10/80	06/30/82	04/07/86
LAB				EL	EL	EL	EL	EL				
LAB NUMBER				90-15044	90-15042	90-10832	89-20184	91-12768				
REMARKS								Helena Landfi				
SAMPLE NUMBER	HYD-5713	HYD-5714	HYD-5715	HYD-5703	HYD-5700	HYD-5769	HYD-5770	HL9104-105	HYD-5797	HYD-5798	HYD-5799	HYD-5800
-- SEMI-VOLATILE EXTRACTABLES --												
TERT-BUTYLBENZENE (ppb)				<1	<1	<1	<1					
-- HYDROCARBONS --												
ORGANIC CARBON (TOTAL)								<2				
-- OTHER PARAMETERS --												
CYANIDE (CN) *TOT								<0.005				
CHEMICAL OXEGEN DEMAND								<1				

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	HL-1	HL-1	HL-4	HL-4	HL-5	HL-5	HL-5	HL-5	HL-6	HL-6	HL-6	HL-6
SAMPLE DATE	10/20/88	05/25/89	09/09/80	06/30/82	09/09/80	06/30/82	06/30/82	04/07/86	09/09/80	09/10/80	06/30/82	04/07/86
LAB												
LAB NUMBER												
SAMPLE NUMBER	HYD-5801	HYD-5802	HYD-5781	HYD-5782	HYD-5783	HYD-5784	HYD-5785	HYD-5786	HYD-5793	HYD-5794	HYD-5795	HYD-5796
-- PHYSICAL PARAMETERS --												
PH			6	7.1	6	7.2			6	7	7.5	
SPEC. COND. (UMHOS/CM)	1100	1000	1220	1650	1500	1280			1200	1070	1000	1300
TOTAL DISS. SOLIDS MEAS.			1035		1293				883	920		
TURBIDITY				34000		5000					2700	
-- COMMON IONS --												
TOTAL HARDNESS AS CACO3	1000	490						960				660
CALCIUM (CA)				179		171	158				147	
MAGNESIUM (MG)				75		54	49				41	
SODIUM (NA)			40	106	55	46	40		35	29	31	
SODIUM (NA) *TOT	22	52						54				42
POTASSIUM (K)			13	13	9	9	6		3	5.5	5	
ALKALINITY AS CACO3	300	630	282		529				294	285		410
BICARBONATE (HCO3)				850		481					415	
CARBONATE AS CO3				0		0					0	
SULFATE (SO4)			264	239	417	262			299	274	188	
CHLORIDE (CL)	37	36		68		71					39	44
-- NUTRIENTS --												
NITRATE (NO3-N)			12	7	0.28	1.44			12	7.15	9	
NITRATE + NITRITE AS N	7.6	7.9						0.83				4.6
PHOSPHORUS (P) *TOT							<0.05					
-- TRACE ELEMENTS --												
ALUMINUM (AL) *DIS							0.4					
ARSENIC (AS) *DIS							<0.05					
BARIUM (BA) *DIS							0.09					
BERYLLIUM (BE) *DIS							<0.01					
BORON (B)							0.49					
CADMIUM (CD) *DIS			0.001		0.0023		<0.01		0.0017	0.0005		
CADMIUM (CD) *TOT	0.03	0.01						0.015				0.004
CHROMIUM (CR) *DIS			0.014		0.018		<0.01		0.017	0.012		
CHROMIUM (CR) *TOT	0.12	0.12										
COPPER (CU) *DIS			0.0037		0.011		<0.01		0.39	0.001		
COPPER (CU) *TOT	1	0.24						0.29				0.1
IRON (FE) *DIS	0.04	<0.03		7.66		1.92	1.92	0.06			16.8	<0.03
LEAD (PB) *DIS			0.043	<0.01	0.024	<0.01	<0.01		0.021	0.042	<0.01	
LEAD (PB) *TOT	1.2	0.51						0.54				0.04

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	HL-1	HL-1	HL-4	HL-4	HL-5	HL-5	HL-5	HL-5	HL-6	HL-6	HL-6	HL-6
SAMPLE DATE	10/20/88	05/25/89	09/09/80	06/30/82	09/09/80	06/30/82	06/30/82	04/07/86	09/09/80	09/10/80	06/30/82	04/07/86
LAB												
LAB NUMBER												
SAMPLE NUMBER	HYD-5801	HYD-5802	HYD-5781	HYD-5782	HYD-5783	HYD-5784	HYD-5785	HYD-5786	HYD-5793	HYD-5794	HYD-5795	HYD-5796
-- TRACE ELEMENTS --												
MANGANESE (MN) *DIS							1.38					
MERCURY (HG) *DIS							<0.02					
MERCURY (HG) *TOT		0.002										
MOLYBDENUM (MO) *DIS							<0.01					
NICKEL (NI) *DIS			0.0089		0.022		0.01		0.0058	0.0036		
NICKEL (NI) *TOT	0.45	0.1						0.04				0.04
SELENIUM (SE) *DIS							<0.05					
SILVER (AG) *DIS							<0.01					
VANADIUM (V) *DIS							<0.01					
ZINC (ZN) *DIS			0.0057		0.8		0.06		0.15	0.0069		
ZINC (ZN) *TOT	2.9	0.76						1.6				0.09
-- SEMI-VOLATILE EXTRACTABLES --												
N-NITROSO-DI-N-BUTYLAMINE (ppb)			281	301	149	171			101	92	86	

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	HL-7	HL-7	HL-7	HL-7	HL-7	HL-7	HL-90-1	HL-90-1	HL-90-1DUP	HL-90-2	HL-90-2	HL90-1A
SAMPLE DATE	09/09/80	06/30/82	04/07/86	06/15/87	10/20/88	05/25/89	05/11/90	04/05/91	04/05/91	05/10/90	04/04/91	02/02/90
LAB							EL	EL	EL	EL	EL	EL
LAB NUMBER							90-12198	91-12771	91-12772	90-12197	91-12767	2766
REMARKS								Helena Landfi	Helena Landfi		Helena Landfi	
SAMPLE NUMBER	HYD-5787	HYD-5788	HYD-5789	HYD-5790	HYD-5791	HYD-5792	HYD-5752	HL9104-108	HL9104-118	HYD-5761	HL9104-104	HYD-5748
-- PHYSICAL PARAMETERS --												
PH	6	7.6						7.7	7.6		7.8	7.8
SPEC. COND. (UMHOS/CM)	620	797	820	910	1000	950						1100
TDS MEAS. @ 180 DEG. C								687	678		489	685
TOTAL DISS. SOLIDS MEAS.	394											
TURBIDITY		4800										
-- COMMON IONS --												
TOTAL HARDNESS AS CACO3			410	550	600	530						528
CALCIUM (CA)		108						144	145		116	
CALCIUM (CA) *DIS												137
MAGNESIUM (MG)		31						48	48		33	
MAGNESIUM (MG) *DIS												45
SODIUM (NA)	22	28						38	37		25	
SODIUM (NA) *DIS												35
SODIUM (NA) *TOT			26	30	13	34						
POTASSIUM (K)	3	6						5	4		3	
POTASSIUM (K) *DIS												3
TOTAL ALKALINITY AS CACO3								402	399		351	395
ALKALINITY AS CACO3	181		220	250	470	360						
BICARBONATE (HCO3)		330						491	487		428	482
CARBONATE AS CACO3								0	0		0	
CARBONATE AS CO3		0										0
SULFATE (SO4)	100	125						140	141		61	132
CHLORIDE (CL)		34	39	40	24	46		33	33		31	31
-- NUTRIENTS --												
AMMONIA (NH3 AS N)								<0.1			<0.1	
NITRATE (NO3-N)	1.06	9										
NITRATE + NITRITE AS N			6.6	7.6	1.8	5.5		7.53			0.83	8.4
-- TRACE ELEMENTS --												
ARSENIC (AS)								<0.005			<0.005	
BARIUM (BA)								<0.1			<0.1	
CADMIUM (CD)								0.001			0.001	
CADMIUM (CD) *DIS	0.0007											0.005
CADMIUM (CD) *TOT			0.004	0.008	0.01	0.002						
CHROMIUM (CR)								<0.02			<0.02	

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	HL-7	HL-7	HL-7	HL-7	HL-7	HL-7	HL-90-1	HL-90-1	HL-90-1DUP	HL-90-2	HL-90-2	HL90-1A
SAMPLE DATE	09/09/80	06/30/82	04/07/86	06/15/87	10/20/88	05/25/89	05/11/90	04/05/91	04/05/91	05/10/90	04/04/91	02/02/90
LAB							EL	EL	EL	EL	EL	EL
LAB NUMBER							90-12198	91-12771	91-12772	90-12197	91-12767	2766
REMARKS								Helena Landfi	Helena Landfi		Helena Landfi	
SAMPLE NUMBER	HYD-5787	HYD-5788	HYD-5789	HYD-5790	HYD-5791	HYD-5792	HYD-5752	HL9104-108	HL9104-118	HYD-5761	HL9104-104	HYD-5748
-- TRACE ELEMENTS --												
CHROMIUM (CR) *DIS	0.018											
CHROMIUM (CR) *TOT				0.04	0.13	0.01						
COPPER (CU) *DIS	0.037											<0.01
COPPER (CU) *TOT			0.07	0.13	0.18	0.06						
IRON (FE)								<0.03			0.12	
IRON (FE) *DIS		9.09	<0.03	0.04	<0.03	<0.03						<0.03
LEAD (PB)								<0.01			<0.01	
LEAD (PB) *DIS	0.062	<0.01										<0.01
LEAD (PB) *TOT			0.03	0.28	0.16	0.04						
MANGANESE (MN)								<0.02			<0.02	
MERCURY (HG)								<0.001			<0.001	
MERCURY (HG) *TOT						<0.002						
NICKEL (NI) *DIS	0.0074											
NICKEL (NI) *TOT			0.01	0.08	0.12	0.01						
SELENIUM (SE)								<0.005			<0.005	
SILVER (AG)								<0.005			<0.005	
ZINC (ZN) *DIS	0.28											0.02
ZINC (ZN) *TOT			0.05	0.27	0.36	0.1						
-- VOLATILE ORGANICS --												
1,1,1-TRICHLOROETHANE (ppb)								7	6.6		1	
1,1,2,2-TETRACHLOROETHANE (ppb)								<1	<1		<1	
1,1,2-TRICHLOROETHANE (ppb)								<1	<1		<1	
1,1-DICHLOROETHANE (ppb)								2.9	2.8		2.2	
1,1-DICHLOROETHENE (ppb)								<0.5	<0.5		<0.5	
1,2-DICHLOROETHANE (ppb)								0.5	0.5		<0.5	
BENZENE (ppb)								<0.5	<0.5		<0.5	
BROMOCHLOROMETHANE (ppb)								<1	<1		<1	
BROMODICHLOROMETHANE (ppb)								<1	<1		<1	
BROMOFORM (ppb)								<1	<1		<1	
BROMOMETHANE (ppb)								<1	<1		<1	
CARBON TETRACHLORIDE (ppb)								<0.5	<0.5		<0.5	
CHLOROBENZENE (ppb)								<1	<1		<1	
CHLOROETHANE (ppb)								<1	<1		<1	
CHLOROFORM (ppb)								4.1	3.9		<1	
CHLOROMETHANE (ppb)								<1	<1		<1	
CIS-1,3-DICHLOROPROPENE (ppb)								<1	<1		<1	

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* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	HL-7	HL-7	HL-7	HL-7	HL-7	HL-7	HL-90-1	HL-90-1	HL-90-1DUP	HL-90-2	HL-90-2	HL90-1A
SAMPLE DATE	09/09/80	06/30/82	04/07/86	06/15/87	10/20/88	05/25/89	05/11/90	04/05/91	04/05/91	05/10/90	04/04/91	02/02/90
LAB							EL	EL	EL	EL	EL	EL
LAB NUMBER							90-12198	91-12771	91-12772	90-12197	91-12767	2766
REMARKS								Helena Landfi	Helena Landfi		Helena Landfi	
SAMPLE NUMBER	HYD-5787	HYD-5788	HYD-5789	HYD-5790	HYD-5791	HYD-5792	HYD-5752	HL9104-108	HL9104-118	HYD-5761	HL9104-104	HYD-5748
-- VOLATILE ORGANICS --												
DIBROMOCHLOROMETHANE (ppb)								<1	<1		<1	
DIBROMOMETHANE (ppb)								<1	<1		<1	
DICHLORODIFLUOROMETHANE (ppb)								8.9	8.8		<1	
ETHYLBENZENE (ppb)								<1	<1		<1	
XYLENE (ppb)								<1	<1		<1	
METHYLENE CHLORIDE (ppb)								3.6	3.5		<1	
TETRACHLOROETHENE (ppb)								12	13		<0.5	
TOLUENE (ppb)								<1	<1		<1	
TRANS-1,2-DICHLOROETHENE (ppb)								<1	<1		<1	
TRANS-1,3-DICHLOROPROPENE (ppb)								<1	<1		<1	
TRICHLOROETHENE (ppb)								2.2	2.2		<0.5	
TRICHLOROFLUOROMETHANE (ppb)								2.8	2.6		<1	
VINYL CHLORIDE (ppb)								<0.5	<0.5		<0.5	
-- SEMI-VOLATILE EXTRACTABLES --												
1,2,3-TRICHLOROPROPANE (ppb)								<1	<1		<1	
1,2,4-TRICHLOROBENZENE (ppb)							<10			<10		
1,2-DICHLOROBENZENE (ppb)							<10			<10		
1,3-DICHLOROBENZENE (ppb)							<10			<10		
1,4-DICHLOROBENZENE (ppb)							<10			<10		
2-METHYL-4 6-DINITROPHENO (ppb)							<50			<50		
2,4,6-TRICHLOROPHENOL (ppb)							<10			<10		
2,4-DICHLOROPHENOL (ppb)							<10			<10		
2,4-DIMETHYLPHENOL (ppb)							<10			<10		
2,4-DINITROPHENOL (ppb)							<50			<50		
2,4-DINITROTOLUENE (ppb)							<10			<10		
2,6-DINITROTOLUENE (ppb)							<10			<10		
2-CHLORONAPHTHALENE (ppb)							<10			<10		
2-CHLOROPHENOL (ppb)							<10			<10		
2-NITROPHENOL (ppb)							<10			<10		
3,3-DICHLOROBENZIDINE (ppb)							<10			<10		
4-BROMOPHENYL PHENYL ETHER (ppb)							<10			<10		
4-CHLORO-3-METHYLPHENOL (ppb)							<10			<10		
4-CHLOROPHENYL PHENYL ETHER (ppb							<10			<10		
4-NITROPHENOL (ppb)							<50			<50		
ACENAPHTHENE (ppb)							<10			<10		
ACENAPHTHYLENE (ppb)							<10			<10		

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	HL-7	HL-7	HL-7	HL-7	HL-7	HL-7	HL-90-1	HL-90-1	HL-90-1DUP	HL-90-2	HL-90-2	HL90-1A
SAMPLE DATE	09/09/80	06/30/82	04/07/86	06/15/87	10/20/88	05/25/89	05/11/90	04/05/91	04/05/91	05/10/90	04/04/91	02/02/90
LAB							EL	EL	EL	EL	EL	EL
LAB NUMBER							90-12198	91-12771	91-12772	90-12197	91-12767	2766
REMARKS								Helena Landfi	Helena Landfi		Helena Landfi	
SAMPLE NUMBER	HYD-5787	HYD-5788	HYD-5789	HYD-5790	HYD-5791	HYD-5792	HYD-5752	HL9104-108	HL9104-118	HYD-5761	HL9104-104	HYD-5748
-- SEMI-VOLATILE EXTRACTABLES --												
ANTHRACENE (ppb)							<10			<10		
AZOBENZENE (1,2-DIPHENYLHYDRAZIN							<10			<10		
BENZIDINE (ppb)							<10			<10		
BENZO (A) ANTHRACENE (ppb)							<10			<10		
BENZO (A) PYRENE (ppb)							<10			<10		
BENZO (B) FLUORANTHENE (ppb)							<10			<10		
BENZO (GHI) PERYLENE (ppb)							<10			<10		
BENZO (K) FLUORANTHENE (ppb)							<10			<10		
BIS (2-CHLOROETHOXY) METHANE (pp							<10			<10		
BIS (2-CHLOROETHYL) ETHER (ppb)							<10			<10		
BIS (2-CHLOROISOPROPYL) ETHER (p							<10			<10		
BIS (2-ETHYLHEXYL) PHTHALATE (pp							<10			<10		
BUTYL BENZYL PHTHALATE (ppb)							<10			<10		
CHRYSENE (ppb)							<10			<10		
DI-N-BUTYLPHTHALATE (ppb)							<10			<10		
DI-N-OCTYL PHTHALATE (ppb)							<10			<10		
DIBENZO (A,H) ANTHRACENE (ppb)							<10			<10		
DIETHYLPHTHALATE (ppb)							<10			<10		
DIMETHYLPHTHALATE (ppb)							<10			<10		
FLUORANTHENE (ppb)							<10			<10		
FLUORENE (ppb)							<10			<10		
HEXACHLOROBENZENE (ppb)							<10			<10		
HEXACHLOROBUTADIENE (ppb)							<10			<10		
HEXACHLOROETHANE (ppb)							<10			<10		
INDENO (1,2,3-CD) PYRENE (ppb)							<10			<10		
ISOPHORONE (ppb)							<10			<10		
N-NITROSO-DI-N-BUTYLAMINE (ppb)	126	197										
N-NITROSO-DI-N-PROPYLAMINE (ppb)							<10			<10		
N-NITROSOPHENYLAMINE (ppb)							<10			<10		
NAPHTHALENE (ppb)							<10			<10		
NITROBENZENE (ppb)							<10			<10		
PENTACHLOROPHENOL (ppb)							<50			<50		
PHENANTHRENE (ppb)							<10			<10		
PHENOL (ppb)							<10			<10		
PYRENE (ppb)							<10			<10		
-- HYDROCARBONS --												
ORGANIC CARBON (TOTAL)								<2			2	

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	HL-7	HL-7	HL-7	HL-7	HL-7	HL-7	HL-90-1	HL-90-1	HL-90-1DUP	HL-90-2	HL-90-2	HL90-1A
SAMPLE DATE	09/09/80	06/30/82	04/07/86	06/15/87	10/20/88	05/25/89	05/11/90	04/05/91	04/05/91	05/10/90	04/04/91	02/02/90
LAB							EL	EL	EL	EL	EL	EL
LAB NUMBER							90-12198	91-12771	91-12772	90-12197	91-12767	2766
REMARKS								Helena Landfi	Helena Landfi		Helena Landfi	
SAMPLE NUMBER	HYD-5787	HYD-5788	HYD-5789	HYD-5790	HYD-5791	HYD-5792	HYD-5752	HL9104-108	HL9104-118	HYD-5761	HL9104-104	HYD-5748
-- OTHER PARAMETERS --												
CYANIDE (CN)								<0.005			<0.005	
CHEMICAL OXEGEN DEMAND								2			<1	

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	HL90-2A	HL90-3	HL90-3	HL90-3A	I-3	LCG-1	LCG-1	MW-1	MW-7	POND	W-1	W-1
SAMPLE DATE	02/03/90	02/02/90	04/05/91	02/02/90	05/08/90	09/09/80	06/30/82	11/13/89	11/11/89	05/06/90	04/03/90	05/06/90
LAB	EL	EL	EL	EL	EL			EL	EL	EL	EL	EL
LAB NUMBER	2767	90-2765	91-12770	2765	90-12196			89-20185	89-20182	90-10828	90-7837	90-10827
REMARKS			Helena Landfi									
SAMPLE NUMBER	HYD-5756	HYD-5749	HL9104-107	HYD-5762	HYD-5759	HYD-5727	HYD-5728	HYD-5753	HYD-5760	HYD-5740	HYD-5737	HYD-5738
-- PHYSICAL PARAMETERS --												
PH	7.9			7.5		6.5	8.2					
PH (pH units)			7.7									
SPEC. COND. (UMHOS/CM)	877			1130		380	492					
TDS MEAS. @ 180 DEG. C	511		662	686								
TOTAL DISS. SOLIDS MEAS.						309						
TURBIDITY							1.5					
-- COMMON IONS --												
TOTAL HARDNESS AS CACO3	444			435								
CALCIUM (CA)							63					
CALCIUM (CA) *DIS	121		108	109								
MAGNESIUM (MG)							21					
MAGNESIUM (MG) *DIS	35		39	40								
SODIUM (NA)						5	8					
SODIUM (NA) *DIS	23		83	80								
POTASSIUM (K)						1.6	4					
POTASSIUM (K) *DIS	3		4	3								
TOTAL ALKALINITY AS CACO3	367		393	400								
ALKALINITY AS CACO3						163						
BICARBONATE (HCO3)	448		479	488			261					
CARBONATE AS CO3	0		0	0			0					
SULFATE (SO4)	62		134	136		35	44					
CHLORIDE (CL)	32		29	30			<1					
-- NUTRIENTS --												
NITRATE (NO3-N)						1.14	1.62					
NITRATE + NITRITE AS N	0.9		6.91	5.7								
NITROGEN AS N			<0.1									
-- TRACE ELEMENTS --												
ARSENIC (AS) *DIS			<0.005									
BARIUM (BA) *DIS			<0.1									
CADMIUM (CD) *DIS	0.005		0.002	0.006		0.01						
CHROMIUM (CR) *DIS			<0.02			0.015						
COPPER (CU) *DIS	<0.01			<0.01		0.0036						
IRON (FE) *DIS	0.06		<0.03	<0.03			1.2					
LEAD (PB) *DIS	<0.01		<0.01	<0.01		0.08	<0.01					

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	HL90-2A	HL90-3	HL90-3	HL90-3A	I-3	LCG-1	LCG-1	MW-1	MW-7	POND	W-1	W-1
SAMPLE DATE	02/03/90	02/02/90	04/05/91	02/02/90	05/08/90	09/09/80	06/30/82	11/13/89	11/11/89	05/06/90	04/03/90	05/06/90
LAB	EL	EL	EL	EL	EL			EL	EL	EL	EL	EL
LAB NUMBER	2767	90-2765	91-12770	2765	90-12196			89-20185	89-20182	90-10828	90-7837	90-10827
REMARKS			Helena Landfi									
SAMPLE NUMBER	HYD-5756	HYD-5749	HL9104-107	HYD-5762	HYD-5759	HYD-5727	HYD-5728	HYD-5753	HYD-5760	HYD-5740	HYD-5737	HYD-5738
-- TRACE ELEMENTS --												
MANGANESE (MN) *DIS			<0.02									
MERCURY (HG) *DIS			<0.001									
NICKEL (NI) *DIS						0.77						
SELENIUM (SE) *DIS			<0.005									
SILVER (AG) *DIS			<0.005									
ZINC (ZN) *DIS	0.02			0.02		0.15						
-- VOLATILE ORGANICS --												
1,1,1,2-TETRACHLOROETHANE (ppb)		<1			<1			<1	<1	<1	<1	<1
1,1,1-TRICHLOROETHANE (ppb)		<0.5	<0.5		2.6			<0.50 *	7.1	<0.5	0.96	<0.5
1,1,2,2-TETRACHLOROETHANE (ppb)		<1	<1		<1			<1	<1	<1	<1	<1
1,1,2-TRICHLOROETHANE (ppb)		<1	<1		<1			<1	<1	<1	<1	<1
1,1-DICHLOROETHANE (ppb)		1.1	<1		1.7			<1	5.8	<1	<1	<1
1,1-DICHLOROETHENE (ppb)		<0.5	<0.5		<0.50 *			<0.5	<0.5	<0.5	<0.5	<0.5
1,1-DICHLOROPROPENE (ppb)		<1			<1			<1	<1	<1	<1	<1
1,2-DIBROMOETHANE (ppb)		<1			<1			<1	<1	<1	<1	<1
1,2-DICHLOROETHANE (ppb)		<0.5	<0.5		<0.5			<0.05	<0.5	<0.5	<0.5	<0.5
1,2-DICHLOROPROPANE (ppb)		<1			<1			<1	<1	<1	<1	<1
2,2-DICHLOROPROPANE (ppb)		<1			<1			<1	<1	<1	<1	<1
2-CHLOROTOLUENE (ppb)		<1			<1			<1	<1	<1	<1	<1
4-CHLOROTOLUENE (ppb)		<1			<1			<1	<1	<1	<1	<1
BENZENE (ppb)		<0.5	<0.5		<0.5			<0.5	<0.5	<0.5	<0.5	<0.5
BROMOBENZENE (ppb)		<1			1			<1	<1	<1	<1	<1
BROMOCHLOROMETHANE (ppb)		<1	<1		<1			<1	<1	<1	<1	<1
BROMODICHLOROMETHANE (ppb)		<1	<1		<1			<1.0 *	<1	<1	<1	<1.0 *
BROMOFORM (ppb)		<1	<1		<1			<1	<1	<1	<1	<1
BROMOMETHANE (ppb)		<1	<1		<1			<1	<1	<1	<1	<1
CARBON TETRACHLORIDE (ppb)		<0.5	<0.5		<0.5			<0.5	<0.5	<0.5	<0.5	<0.5
CHLOROBENZENE (ppb)		<1	<1		<1			<1	<1	<1	<1	<1
CHLOROETHANE (ppb)		<1	<1		<1			<1	<1	<1	<1	<1
CHLOROFORM (ppb)		5.5	5.8		3.8			3.5	2.3	<1	<1.0 *	7.9
CHLOROMETHANE (ppb)			<1									
CIS-1,2-DICHLOROETHENE (ppb)		1.8			1.1			<1	<1	<1	<1	<1
CIS-1,3-DICHLOROPROPENE (ppb)		<1	<1		<1			<1	<1	<1	<1	<1
CIS-1,3-DICHLOROPROPYLENE (ppb)		<1.0 *			3.9			<1	6.3	<1	<1	<1.0 *
DIBROMOCHLOROMETHANE (ppb)		<1	<1		<1			<1	<1	<1	<1	<1
DIBROMOMETHANE (ppb)		<1	<1		<1			<1	<1	<1	<1	<1

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	HL90-2A	HL90-3	HL90-3	HL90-3A	I-3	LCG-1	LCG-1	MW-1	MW-7	POND	W-1	W-1
SAMPLE DATE	02/03/90	02/02/90	04/05/91	02/02/90	05/08/90	09/09/80	06/30/82	11/13/89	11/11/89	05/06/90	04/03/90	05/06/90
LAB	EL	EL	EL	EL	EL			EL	EL	EL	EL	EL
LAB NUMBER	2767	90-2765	91-12770	2765	90-12196			89-20185	89-20182	90-10828	90-7837	90-10827
REMARKS			Helena Landfi									
SAMPLE NUMBER	HYD-5756	HYD-5749	HL9104-107	HYD-5762	HYD-5759	HYD-5727	HYD-5728	HYD-5753	HYD-5760	HYD-5740	HYD-5737	HYD-5738
-- OTHER PARAMETERS --												
CYANIDE (CN) *TOT			<0.005									
CHEMICAL OXEGEN DEMAND			3									

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All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	W-5	W-6	W-6	W-82-2	W-82-4	W-82-4	W-83-7	W-GC1
SAMPLE DATE	05/06/90	05/06/90	05/06/90	11/11/89	11/11/89	05/11/90	11/11/89	04/03/90
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10829	90-10830	90-10830	89-20181	89-20180	90-12199	89-20183	7837
REMARKS		DUPLICATE						
SAMPLE NUMBER	HYD-5741	HYD-5774	HYD-5775	HYD-5754	HYD-5743	HYD-5744	HYD-5771	HYD-5780
-- PHYSICAL PARAMETERS --								
PH								7.4
SPEC. COND. (UMHOS/CM)								767
-- COMMON IONS --								
TOTAL HARDNESS AS CACO3								321
CALCIUM (CA) *DIS								85
MAGNESIUM (MG) *DIS								26
SODIUM (NA) *DIS								43
POTASSIUM (K) *DIS								3
BICARBONATE (HCO3)								302
CARBONATE AS CO3								0
SULFATE (SO4)								104
CHLORIDE (CL)								35
-- NUTRIENTS --								
NITRATE + NITRITE AS N								4.7
-- TRACE ELEMENTS --								
CADMIUM (CD) *DIS								<0.001
COPPER (CU) *DIS								<0.01
IRON (FE) *DIS								<0.03
LEAD (PB) *DIS								<0.01
ZINC (ZN) *DIS								0.02
-- VOLATILE ORGANICS --								
1,1,1,2-TETRACHLOROETHANE (ppb)	<1	<1	<1	<1	<1		<1	
1,1,1-TRICHLOROETHANE (ppb)	<0.5	<0.5	<0.5	<0.5	9.8		<0.5	
1,1,2,2-TETRACHLOROETHANE (ppb)	<1	<1	<1	<1	<1		<1	
1,1,2-TRICHLOROETHANE (ppb)	<1	<1	<1	<1	<1		<1	
1,1-DICHLOROETHANE (ppb)	<1	<1	<1	<1	2.4		<1.0 *	
1,1-DICHLOROETHENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.50 *		<0.5	
1,1-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1		<1	
1,2-DIBROMOETHANE (ppb)	<1	<1	<1	<1	<1		<1	
1,2-DICHLOROETHANE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	
1,2-DICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1		<1	
2,2-DICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1		<1	
2-CHLOROTOLUENE (ppb)	<1	<1	<1	<1	<1		<1	

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Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	W-5	W-6	W-6	W-82-2	W-82-4	W-82-4	W-83-7	W-GC1
SAMPLE DATE	05/06/90	05/06/90	05/06/90	11/11/89	11/11/89	05/11/90	11/11/89	04/03/90
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10829	90-10830	90-10830	89-20181	89-20180	90-12199	89-20183	7837
REMARKS		DUPLICATE						
SAMPLE NUMBER	HYD-5741	HYD-5774	HYD-5775	HYD-5754	HYD-5743	HYD-5744	HYD-5771	HYD-5780
-- VOLATILE ORGANICS --								
4-CHLOROTOLUENE (ppb)	<1	<1	<1	<1	<1		<1	
BENZENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	
BROMOBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
BROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1		<1	
BROMODICHLOROMETHANE (ppb)	<1	<1	<1	<1	<1		<1	
BROMOFORM (ppb)	<1	<1	<1	<1	<1		<1	
BROMOMETHANE (ppb)	<1	<1	<1	<1	<1		<1	
CARBON TETRACHLORIDE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	
CHLOROBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
CHLOROETHANE (ppb)	<1	<1	<1	<1	<1		<1	
CHLOROFORM (ppb)	2.3	2	2	<1	<1.0 *		<1	
CIS-1,2-DICHLOROETHENE (ppb)	<1	<1	<1	<1	<1.0 *		4.4	
CIS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1		<1	
CIS-1,3-DICHLOROPROPYLENE (ppb)	<1.0 *	<1	<1		33		<1.0 *	
DIBROMOCHLOROMETHANE (ppb)	<1	<1	<1	<1	<1		<1	
DIBROMOMETHANE (ppb)	<1	<1	<1	<1	<1		<1	
DICHLORODIFLUOROMETHANE (ppb)	1	<1	<1	<1	67		<1.0 *	
ETHYLBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
XYLENE (ppb)	<1	<1	<1	<1	<1		<1	
M-P XYLENE (ppb)	<1	<1	<1	<1	<1		<1	
O-XYLENE (ppb)	<1	<1	<1	<1	<1		<1	
METHYLENE CHLORIDE (ppb)	<1	<1	<1	<1	7.5		<1.0 *	
STYRENE (ppb)	<1	<1	<1	<1	<1		<1	
TETRACHLOROETHENE (ppb)	<0.50 *	<0.5	<0.5	<0.5	4.8		<0.5	
TOLUENE (ppb)	<1	<1	<1	<1	<1		<1	
TRANS-1,2-DICHLOROETHENE (ppb)	<1	<1	<1	<1	<1		<1	
TRANS-1,3-DICHLOROPROPENE (ppb)	<1	<1	<1	<1	<1		<1	
TRICHLOROETHENE (ppb)	<0.5	<0.5	<0.5	<0.5	2.9		<0.5	
TRICHLOROFLUOROMETHANE (ppb)	<1	<1	<1	<1	40		<1	
VINYL CHLORIDE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	
-- SEMI-VOLATILE EXTRACTABLES --								
1,2,3-TRICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
1,2,3-TRICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1		<1	
1,2,4-TRICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<10	<1	
1,2,4-TRIMETHYLBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
1,2-DIBROMO-3-CHLOROPROPANE (ppb	<1	<1	<1	<1	<1		<1	

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	W-5	W-6	W-6	W-82-2	W-82-4	W-82-4	W-83-7	W-GC1
SAMPLE DATE	05/06/90	05/06/90	05/06/90	11/11/89	11/11/89	05/11/90	11/11/89	04/03/90
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10829	90-10830	90-10830	89-20181	89-20180	90-12199	89-20183	7837
REMARKS		DUPLICATE						
SAMPLE NUMBER	HYD-5741	HYD-5774	HYD-5775	HYD-5754	HYD-5743	HYD-5744	HYD-5771	HYD-5780
-- SEMI-VOLATILE EXTRACTABLES --								
1,2-DICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<10	<1	
1,3,5-TRIMETHYLBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
1,3-DICHLOROBENZENE (ppb)	<1	<1	<1	<1	<1	<10	<1	
1,3-DICHLOROPROPANE (ppb)	<1	<1	<1	<1	<1		<1	
1,4-DICHLOROBENZENE (ppb)	<0.5	<0.5	<0.5	<0.5	<0.5	<10	<0.5	
2-METHYL-4 6-DINITROPHENO (ppb)						<50		
2,4,6-TRICHLOROPHENOL (ppb)						<10		
2,4-DICHLOROPHENOL (ppb)						<10		
2,4-DIMETHYLPHENOL (ppb)						<10		
2,4-DINITROPHENOL (ppb)						<50		
2,4-DINITROTOLUENE (ppb)						<10		
2,6-DINITROTOLUENE (ppb)						<10		
2-CHLORONAPHTHALENE (ppb)						<10		
2-CHLOROPHENOL (ppb)						<10		
2-NITROPHENOL (ppb)						<10		
3,3-DICHLOROBENZIDINE (ppb)						<10		
4-BROMOPHENYL PHENYL ETHER (ppb)						<10		
4-CHLORO-3-METHYLPHENOL (ppb)						<10		
4-CHLOROPHENYL PHENYL ETHER (ppb						<10		
4-NITROPHENOL (ppb)						<50		
ACENAPHTHENE (ppb)						<10		
ACENAPHTHYLENE (ppb)						<10		
ANTHRACENE (ppb)						<10		
AZOBENZENE (1,2-DIPHENYLHYDRAZIN						<10		
BENZIDINE (ppb)						<10		
BENZO (A) ANTHRACENE (ppb)						<10		
BENZO (A) PYRENE (ppb)						<10		
BENZO (B) FLUORANTHENE (ppb)						<10		
BENZO (GHI) PERYLENE (ppb)						<10		
BENZO (K) FLUORANTHENE (ppb)						<10		
BIS (2-CHLOROETHOXY) METHANE (pp						<10		
BIS (2-CHLOROETHYL) ETHER (ppb)						<10		
BIS (2-CHLOROISOPROPYL) ETHER (p						<10		
BIS (2-ETHYLHEXYL) PHTHALATE (pp						<10		
BUTYL BENZYL PHTHALATE (ppb)						<10		
CHRYSENE (ppb)						<10		
DI-N-BUTYLPHTHALATE (ppb)						<10		

* DIS - Dissolved
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All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

Table 2.3 - SUMMARY OF HELENA LANDFILL AREA WATER QUALITY
Client: CHHL01 - City of Helena
Project: Hlna Landfll Mtrng

Sample Type: Other Sites

SITE CODE	W-5	W-6	W-6	W-82-2	W-82-4	W-82-4	W-83-7	W-GC1
SAMPLE DATE	05/06/90	05/06/90	05/06/90	11/11/89	11/11/89	05/11/90	11/11/89	04/03/90
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10829	90-10830	90-10830	89-20181	89-20180	90-12199	89-20183	7837
REMARKS		DUPLICATE						
SAMPLE NUMBER	HYD-5741	HYD-5774	HYD-5775	HYD-5754	HYD-5743	HYD-5744	HYD-5771	HYD-5780
-- SEMI-VOLATILE EXTRACTABLES --								
DI-N-OCTYL PHTHALATE (ppb)						<10		
DIBENZO (A,H) ANTHRACENE (ppb)						<10		
DIETHYLPHTHALATE (ppb)						<10		
DIMETHYLPHTHALATE (ppb)						<10		
FLUORANTHENE (ppb)						<10		
FLUORENE (ppb)						<10		
HEXACHLOROBENZENE (ppb)						<10		
HEXACHLOROBUTADIENE (ppb)	<1	<1	<1	<1	<1	<10	<1	
HEXACHLOROETHANE (ppb)						<10		
INDENO (1,2,3-CD) PYRENE (ppb)						<10		
ISOPHORONE (ppb)						<10		
ISOPROPYLBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
N-BUTYLBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
N-NITROSO-DI-N-PROPYLAMINE (ppb)						<10		
N-NITROSOPHENYLAMINE (ppb)						<10		
N-PROPYLBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
NAPHTHALENE (ppb)	<1	<1	<1	<1	<1	<10	<1	
NITROBENZENE (ppb)						<10		
P-ISOPROPYLTOLUENE (ppb)	<1	<1	<1	<1	<1		<1	
PENTACHLOROPHENOL (ppb)						<50		
PHENANTHRENE (ppb)						<10		
PHENOL (ppb)						<10		
PYRENE (ppb)						<10		
SEC-BUTYLBENZENE (ppb)	<1	<1	<1	<1	<1		<1	
TERT-BUTYLBENZENE (ppb)	<1	<1	<1	<1	<1		<1	

* DIS - Dissolved
* TOT - Total
All quantities in mg/L unless otherwise noted
Blank line indicates parameter not tested.

APPENDIX B.

STORM DRAIN OUTFALL FLOW MEASUREMENTS

HYDROMETRICS

HELENA, MT

FLOW DISCHARGE CALCULATION

Project: City of Helena Landfill
Station: hlsr-2
Date Measured: 05-16-91

STATION	DIST. (ft)	WIDTH (ft)	DEPTH (ft)	VEL. (ft/sec)	AREA (ft^2)	DISCHARGE (cfs)
						0
E.O.W.	0.30	0.15	0	0		
1	0.60	0.25	0.15	0.28	0.04	0.01
2	0.80	0.20	0.20	0.25	0.04	0.00
3	1.00	0.20	0.20	0.30	0.04	0.01
4	1.20	0.20	0.30	0.30	0.06	0.02
5	1.40	0.20	0.30	0.38	0.06	0.02
6	1.60	0.20	0.25	0.43	0.05	0.02
7	1.80	0.20	0.20	0.32	0.04	0.01
8	2.00	0.20	0.15	0.22	0.03	0.00
9	2.20	0.15	0.05	0.17	0.00	0.00
E.O.W.	2.30	0.05	0	0		0
					Flow =	0.12

Flow Method: Pygmy Current Meter
Calc. Method: Rectangular Area Method
Gage Height: ft. Water Temp. (C): Air Temp. (C):
Weather: Partly Cloudy Measured by: WGP
Measurement Conditions: FAIR (8 %)
Calculated Flow: 0.12 + 0.00cfs
Process program and date: HCM-05 (05-17-1991)

25' downstream from tunnel

HYDROMETRICS HELENA, MT

FLOW DISCHARGE CALCULATION

Project: City of Helena Landfill
Station: HLSR-1
Date Measured: 05-16-91

STATION	DIST. (ft)	WIDTH (ft)	DEPTH (ft)	VEL. (ft/sec)	AREA (ft^2)	DISCHARGE (cfs)
E.O.W.	2.00	0.15	0	0		0
1	2.30	0.30	0.15	0.00	0.04	0.00
2	2.60	0.30	0.30	0.30	0.09	0.03
3	2.90	0.30	0.40	0.28	0.12	0.03
4	3.20	0.30	0.55	0.17	0.16	0.03
5	3.50	0.30	0.60	0.22	0.18	0.04
6	3.80	0.30	0.60	0.17	0.18	0.03
7	4.10	0.30	0.60	0.08	0.18	0.01
8	4.40	0.30	0.55	0.05	0.16	0.00
9	4.70	0.30	0.45	0.00	0.13	0.00
10	5.00	0.30	0.30	0.00	0.09	0.00
E.O.W.	5.30	0.15	0	0		0
					Flow =	0.18

Flow Method: Pygmy Current Meter
Calc. Method: Rectangular Area Method
Gage Height: ft. Water Temp. (C): Air Temp. (C):
Weather: Partly Cloudy Measured by: wgp
Measurement Conditions: FAIR (8 %)
Calculated Flow: 0.18 + 0.01cfs
Process program and date: HCM-05 (05-17-1991)

65' Inside tunnel

HYDROMETRICS

Boise, Id.

STREAM GAGING - PIGMY METER (0.6 DEPTH)

PROJECT: COH-Landfill DATE: 5

SITE: HSR 3 FLOW:

DIST. FROM INITIAL POINT	WIDTH	DEPTH	AREA	REVOLUTIONS	TIME IN SECONDS	POINT VELOCITY (FT/SEC)	DISCHARGE (CFS)
				1			
	0.33						
	6"		V-Wdyck				
			11				
	.1564		CFS				

PARTY: COMP. BY: CKED. BY:

WEATHER: AIR TEMP.: WATER TEMP.:

STREAM & BOTTOM COND.:

MEAS. COND. & RATING: GOOD (5%), FAIR (8%), POOR (12%), VERY POOR (20%).

OTHER (EXPLAIN):

GAGE HEIGHT: REMARKS:

143' OUTSIDE TUNNEL

HYDROMETRICS Belen, NM

STREAM GAGING – PIGMY METER (0.8 DEPTH)

PROJECT COH – Landfill DATE 5-16-91

SITE HSK-4 FLOW

DIST. FROM INITIAL POINT	WIDTH	DEPTH	AREA	REVOLUTIONS	TIME IN SECONDS	POINT VELOCITY (FT/SEC)	DISCHARGE (CFS)
	0.17						
			V-NOTCH				
	=	.0298 CFS					
	WATER GONE						
					378		

PARTY _____ COMP. BY _____ CKED. BY _____

WEATHER _____ AIR TEMP. _____ WATER TEMP. _____

STREAM & BOTTOM COND. _____

MEAS. COND. & RATING GOOD (5%), FAIR (8%), POOR (12%), VERY POOR (20%),

OTHER (EXPLAIN) _____

GAGE HEIGHT _____ REMARKS _____

300' outside Tunnel

APPENDIX C.

WATER QUALITY DATA

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10827
DATE: 05/23/90 dya

WATER ANALYSIS
Helena Landfill
HL-9005-110
Sampled 05/06/90 @ 1125
Submitted 05/08/90

#1

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0*
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	7.9
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0*
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	0.83
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10829
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill
HL-9005-112
Sampled 05/06/90 @ 1145
Submitted 05/08/90

ES

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	2.3	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50*	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT PAGE : 1

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-13087
Date : 6/14/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-110
Sample Date : 4/13/91
Sample Time : 13:00:00
Sample Received : 4/16/91
Helena Landfill
Revised 06/14/91

LABORATORY DATA:

Acetone	(ug/l)	<10
Acrolein	(ug/l)	<10
Acrylonitrile	(ug/l)	<10
Benzene	(ug/l)	<0.50
Bromochloromethane	(ug/l)	<1.0
Bromodichloromethane	(ug/l)	<1.0
cis-1,3-Dichloropropene	(ug/l)	<1.0
trans-1,3-Dichloropropene	(ug/l)	<1.0
1,4-Difluorobenzene	(ug/l)	<10
Ethanol	(mg/l)	<10
Ethylbenzene	(ug/l)	<1.0
Ethyl methacrylate	(ug/l)	<10
4-Bromofluorobenzene	(ug/l)	<10
Bromoform	(ug/l)	<1.0
Bromomethane	(ug/l)	<1.0
2-Butanone(Methyl Ethyl Ketone)	(ug/l)	<10
Carbon disulfide	(ug/l)	<10
Carbon Tetrachloride	(ug/l)	<0.50
Chlorobenzene	(ug/l)	<1.0
Dibromochloromethane	(ug/l)	<1.0
Chloroethane	(ug/l)	<1.0
2-Chloroethylvinyl ether	(ug/l)	<10
Chloroform	(ug/l)	2.3
Chloromethane	(ug/l)	<1.0
Dibromomethane	(ug/l)	<1.0
1,4-Dichloro-2-butene	(ug/l)	<10
Dichlorodifluoromethane	(ug/l)	<1.0
1,1-Dichloroethane	(ug/l)	<1.0
1,2-Dichloroethane	(ug/l)	<0.50
2-Hexanone	(ug/l)	<10
Iodomethane	(ug/l)	<10
Methylene Chloride	(ug/l)	<1.0
4-Methyl-2-pentanone	(ug/l)	<10
cis-1,2-Dichloroethene	(ug/l)	<0.50
trans-1,2-Dichloroethene	(ug/l)	<1.0
Styrene	(ug/l)	<1.0

CC:

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-13087
Date : 6/14/91

WATER ANALYSIS REPORT
Sample Pt Name : HL9104-110
Sample Date : 4/13/91
Sample Time : 13:00:00
Sample Received : 4/16/91
Helena Landfill
Revised 06/14/91

LABORATORY DATA:		
1,1,2,2-Tetrachloroethane	(ug/l)	<1.0
Tetrachloroethene	(ug/l)	0.50
Toluene	(ug/l)	<1.0
1,1,1-Trichloroethane	(ug/l)	<0.50
1,1,2-Trichloroethane	(ug/l)	<1.0
Trichloroethene	(ug/l)	<0.50
Trichlorofluoromethane	(ug/l)	<1.0
1,2,3-Trichloropropane	(ug/l)	<10
Vinyl acetate	(ug/l)	<0.50
Vinyl chloride	(ug/l)	<1.0
Xylenes	(ug/l)	<1.0

cc:

ENERGY LABORATORIES, INC.
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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

LAB NO.: 90-10830
DATE: 05/23/90 dya

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

WATER ANALYSIS

Helena Landfill
HL-9005-113
Sampled 05/06/90 @ 1200
Submitted 05/08/90

#6

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	2.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

LAB NO.: 90-10830 dup
DATE: 05/23/90 dya

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

QUALITY ASSURANCE - DUPLICATE ANALYSIS
Helena Landfill
HL-9005-113
Sampled 05/06/90 @ 1200
Submitted 05/08/90
Dup #6

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	2.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<0.50
1,4-Dichlorobenzene	<1.0
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15042
DATE: 06/18/90 dya

WATER ANALYSIS

Helena City Landfill
HL-9006-104
Sampled 06/06/90 @ 1210
Submitted 06/07/90
#9

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	<1.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

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800-873-5227

LABORATORY REPORT

LAB NO.: 90-3298
DATE: 02/20/90 dya

TO: Hydrometrics
ADDRESS: Bill Peery
2727 Airport Road
Helena, MT 59601

WATER ANALYSIS

City of Helena
HL90-10
Sampled 02/16/90 @ 9:30
Submitted 02/19/90

#13

FEB 1990
RECEIVED

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	4.3
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0*
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0*
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0*
Chloroform	2.9
Bromochloromethane	<1.0
1,1,1-Trichloroethane	0.78
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50*
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	2.7
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA method 502.2.

*Present but less than the practical quantitation limit.

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LABORATORY REPORT

LAB NO.: 90-10822
DATE: 05/23/90 dya

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

WATER ANALYSIS

Helena Landfill
HL-9005-105
Sampled 05/04/90 @ 0930
Submitted 05/08/90

#13

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	2.3
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0*
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0*
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0*
Chloroform	4.4
Bromochloromethane	<1.0
1,1,1-Trichloroethane	0.79
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	0.74
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	2.3
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	1.9

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12763
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-100
Sample Date : 4/ 4/91
Sample Time : 11:30:00
Sample Received : 4/ 9/91

Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:		
Acetone	(ug/l)	<10
Acrolein	(ug/l)	<10
Acrylonitrile	(ug/l)	<0.50
Benzene	(ug/l)	<1.0
Bromochloromethane	(ug/l)	<1.0
Bromodichloromethane	(ug/l)	<1.0
[illegible],3-Dichloropropene	(ug/l)	<1.0
[illegible]s-1,3-Dichloropropene	(ug/l)	<1.0
1,4-Difluorobenzene	(mg/l)	<10
Ethanol	(ug/l)	<10
Ethylbenzene	(ug/l)	<1.0
Ethyl methacrylate	(ug/l)	<10
4-Bromofluorobenzene	(ug/l)	<10
Bromoform	(ug/l)	<1.0
Bromomethane	(ug/l)	<1.0
2-Butanone(Methyl Ethyl Ketone)	(ug/l)	<10
Carbon disulfide	(ug/l)	<10
Carbon Tetrachloride	(ug/l)	<0.50
Chlorobenzene	(ug/l)	<1.0
Dibromochloromethane	(ug/l)	<1.0
Chloroethane	(ug/l)	<1.0
2-Chloroethylvinyl ether	(ug/l)	<10
Chloroform	(ug/l)	3.6
Chloromethane	(ug/l)	<1.0
Dibromomethane	(ug/l)	<1.0
1,4-Dichloro-2-butene	(ug/l)	<10
Dichlorodifluoromethane	(ug/l)	2.4
1,1-Dichloroethane	(ug/l)	<1.0*
1,2-Dichloroethane	(ug/l)	<0.50
2-Hexanone	(ug/l)	<10
Iodomethane	(ug/l)	<10
Methylene Chloride	(ug/l)	<1.0
[illegible]ethyl-2-pentanone	(ug/l)	<10
[illegible]-Dichloroethene	(ug/l)	<0.50
[illegible]ans-1,2-Dichloroethene	(ug/l)	<1.0

cc:

ENERGY LABORATORIES

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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12763
Date : 6/21/91

WATER ANALYSIS REPORT
Sample Pt Name : HL9104-100
Sample Date : 4/ 4/91
Sample Time : 11:30:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:		
Styrene	(ug/l)	<1.0
1,1,2,2-Tetrachloroethane	(ug/l)	<1.0
Toluene	(ug/l)	<1.0
1,1,1-Trichloroethane	(ug/l)	0.88
1,1,2-Trichloroethane	(ug/l)	<1.0
[illegible]loroethene	(ug/l)	0.50
[illegible]chlorofluoromethane	(ug/l)	<1.0*
1,2,3-Trichloropropane	(ug/l)	<1.0
Vinyl acetate	(ug/l)	<10
Vinyl chloride	(ug/l)	<0.50
Xylenes	(ug/l)	<1.0
Tetrachloroethene	(ug/l)	3.4

cc:

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10823
DATE: 05/23/90 dya

WATER ANALYSIS
Helena Landfill
HL-9005-106
Sampled 05/04/90 @ 0945
Submitted 05/08/90

#19

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	<1.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10825
DATE: 05/23/90 dya

WATER ANALYSIS
Helena Landfill
HL-9005-108
Sampled 05/06/90 @ 1110
Submitted 05/08/90

#20

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10826
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill
HL-9005-109
Sampled 05/06/90 @ 1115
Submitted 05/08/90

#23

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	6.6
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0*
1,1-Dichloroethene	<0.50*
Methylene Chloride	1.1
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	1.1
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0*
Chloroform	7.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	1.9
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	1.8
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0*
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	8.1
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	4.5

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10817
DATE: 05/23/90 dya

WATER ANALYSIS
Helena Landfill
HL-9005-100
Sampled 05/03/90 @ 1100
Submitted 05/08/90

#26

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	<1.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES

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P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15038
DATE: 06/18/90 dya

WATER ANALYSIS

Helena City Landfill
HL-9006-100
Sampled 06/05/90 @ 1030
Submitted 06/07/90
#28

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0*
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	14	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50*	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	1.9	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	7.4	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0*	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10820
DATE: 05/23/90 dya

WATER ANALYSIS
Helena Landfill
HL-9005-103
Sampled 05/03/90 @ 1250
Submitted 05/08/90

#31

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	10.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0*
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	0.60
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10820 dup
DATE: 05/23/90 dya

QUALITY ASSURANCE - DUPLICATE ANALYSIS
Helena Landfill
HL-9005-103
Sampled 05/03/90 @ 1250
Submitted 05/08/90

Dup #31

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	9.9	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0*	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	0.55	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

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LABORATORY REPORT PAGE : 1

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-13088
Date : 6/14/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-111
Sample Date : 4/13/91
Sample Time : 13:20:00
Sample Received : 4/16/91
Helena Landfill
Revised 06/14/91

LABORATORY DATA:

Acetone	(ug/l)	<10
Acrolein	(ug/l)	<10
Acrylonitrile	(ug/l)	<10
Benzene	(ug/l)	<0.50
Bromochloromethane	(ug/l)	<1.0
Bromodichloromethane	(ug/l)	<1.0
[illegible]1,3-Dichloropropene	(ug/l)	<1.0
[illegible]s-1,3-Dichloropropene	(ug/l)	<1.0
1,4-Difluorobenzene	(ug/l)	<10
Ethanol	(mg/l)	<10
Ethylbenzene	(ug/l)	<1.0
Ethyl methacrylate	(ug/l)	<10
4-Bromofluorobenzene	(ug/l)	<10
Bromoform	(ug/l)	<1.0
Bromomethane	(ug/l)	<1.0
2-Butanone(Methyl Ethyl Ketone)	(ug/l)	<10
Carbon disulfide	(ug/l)	<10
Carbon Tetrachloride	(ug/l)	<0.50
Chlorobenzene	(ug/l)	<1.0
Dibromochloromethane	(ug/l)	<1.0
Chloroethane	(ug/l)	<1.0
2-Chloroethylvinyl ether	(ug/l)	<10
Chloroform	(ug/l)	7.7
Chloromethane	(ug/l)	<1.0
Dibromomethane	(ug/l)	<1.0
1,4-Dichloro-2-butene	(ug/l)	<10
Dichlorodifluoromethane	(ug/l)	<1.0
1,1-Dichloroethane	(ug/l)	<1.0
1,2-Dichloroethane	(ug/l)	<0.50
2-Hexanone	(ug/l)	<10
Iodomethane	(ug/l)	<10
Methylene Chloride	(ug/l)	<1.0
[illegible]ethyl-2-pentanone	(ug/l)	<10
[illegible]-Dichloroethene	(ug/l)	<0.50
trans-1,2-Dichloroethene	(ug/l)	<1.0
Styrene	(ug/l)	<1.0

cc:

ENERGY LABORATORIES

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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-13088
Date : 6/14/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-111
Sample Date : 4/13/91
Sample Time : 13:20:00
Sample Received : 4/16/91
Helena Landfill
Revised 06/14/91

LABORATORY DATA:

1,1,2,2-Tetrachloroethane	(ug/l)	<1.0
Tetrachloroethene	(ug/l)	<0.50*
Toluene	(ug/l)	<1.0
1,1,1-Trichloroethane	(ug/l)	<0.50
1,1,2-Trichloroethane	(ug/l)	<1.0
Trichloroethene	(ug/l)	<0.50
Trichlorofluoromethane	(ug/l)	<1.0
1,2,3-Trichloropropane	(ug/l)	<1.0
Vinyl acetate	(ug/l)	<10
Vinyl chloride	(ug/l)	<0.50
Xylenes	(ug/l)	<1.0

*Present but less than the practical quantitation limits.

cc:

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10818
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill
HL-9005-101
Sampled 05/03/90 @ 1140
Submitted 05/08/90

#32

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	<1.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10824
DATE: 05/23/90 dya

WATER ANALYSIS
Helena Landfill
HL-9005-107
Sampled 05/06/90 @ 1100
Submitted 05/08/90

#34

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	5.6	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	2.2	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10824
DATE: 05/23/90 dya

WATER ANALYSIS
Helena Landfill
HL-9005-107
Sampled 05/06/90 @ 1100
Submitted 05/08/90

#34

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	5.6	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	2.2	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15040
DATE: 06/18/90 dya

WATER ANALYSIS

Helena City Landfill
HL-9006-102
Sampled 06/05/90 @ 1100
Submitted 06/07/90

#36

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	<1.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

36 DUP

ENERGY LABORATORIES, INC.
PO. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15040 dup
DATE: 06/18/90 dya

QUALITY ASSURANCE - DUPLICATE ANALYSIS

Helena City Landfill
HL-9006-102
Sampled 06/05/90 @ 1100
Submitted 06/07/90
#36 Duplicate (LAB)

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	<1.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10821
DATE: 05/23/90 dya

WATER ANALYSIS
Helena Landfill
HL-9005-104
Sampled 05/03/90 @ 1310
Submitted 05/08/90

#38

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0*	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	9.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50*	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0*	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	1.1	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10833
DATE: 05/23/90 dya

WATER ANALYSIS
Helena Landfill
HL-9005-204
Sampled 05/03/90 @ 1340
Submitted 05/08/90

Dup #38

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	7.9	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50*	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0*	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	0.97	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10833
DATE: 05/23/90 dya

WATER ANALYSIS
Helena Landfill
HL-9005-204
Sampled 05/03/90 @ 1340
Submitted 05/08/90

Dup #38

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	7.9
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50*
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0*
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	0.97
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10831
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill
HL-9005-114
Sampled 05/06/90 @ 1215
Submitted 05/08/90

#40

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	4.5
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0*
1,1-Dichloroethene	<0.50*
Methylene Chloride	1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	1.5
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	2.0
Chloroform	11.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	1.3
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	1.3
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0*
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	8.0
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	4.1

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-13086
Date : 6/14/91

WATER ANALYSIS REPORT
Sample Pt Name : HL9104-109
Sample Date : 4/13/91
Sample Time : 13:40:00
Sample Received : 4/16/91
Helena Landfill
Revised 06/14/91

JUN

LABORATORY DATA:		
Acetone	(ug/l)	<10
Acrolein	(ug/l)	<10
Acrylonitrile	(ug/l)	<10
Benzene	(ug/l)	<0.50
Bromochloromethane	(ug/l)	<1.0
Bromodichloromethane	(ug/l)	<1.0*
1,3-Dichloropropene	(ug/l)	<1.0
cis-1,3-Dichloropropene	(ug/l)	<1.0
1,4-Difluorobenzene	(mg/l)	<10
Ethanol	(ug/l)	<10
Ethylbenzene	(ug/l)	<1.0
Ethyl methacrylate	(ug/l)	<10
4-Bromofluorobenzene	(ug/l)	<10
Bromoform	(ug/l)	<1.0
Bromomethane	(ug/l)	<1.0
2-Butanone(Methyl Ethyl Ketone)	(ug/l)	<10
Carbon disulfide	(ug/l)	<10
Carbon Tetrachloride	(ug/l)	<0.50
Chlorobenzene	(ug/l)	<1.0
Dibromochloromethane	(ug/l)	<1.0
Chloroethane	(ug/l)	<1.0
2-Chloroethylvinyl ether	(ug/l)	<10
Chloroform	(ug/l)	11
Chloromethane	(ug/l)	<1.0
Dibromomethane	(ug/l)	<1.0
1,4-Dichloro-2-butene	(ug/l)	<10
Dichlorodifluoromethane	(ug/l)	2.1
1,1-Dichloroethane	(ug/l)	1.2
1,2-Dichloroethane	(ug/l)	<0.50
2-Hexanone	(ug/l)	<10
Iodomethane	(ug/l)	<10
Methylene Chloride	(ug/l)	<1.0*
4-Methyl-2-pentanone	(ug/l)	<10
cis-1,2-Dichloroethene	(ug/l)	<0.50
trans-1,2-Dichloroethene	(ug/l)	<1.0
Styrene	(ug/l)	<1.0

cc:

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-13086
Date : 6/14/91

WATER ANALYSIS REPORT
Sample Pt Name : HL9104-109
Sample Date : 4/13/91
Sample Time : 13:40:00
Sample Received : 4/16/91
Helena Landfill
Revised 06/14/91

LABORATORY DATA:		
1,1,2,2-Tetrachloroethane	(ug/l)	<1.0
Tetrachloroethene	(ug/l)	5.6
Toluene	(ug/l)	<1.0
1,1,1-Trichloroethane	(ug/l)	1.0
1,1,2-Trichloroethane	(ug/l)	<1.0
Trichloroethene	(ug/l)	0.88
Trichlorofluoromethane	(ug/l)	<1.0*
1,2,3-Trichloropropane	(ug/l)	<1.0
Vinyl acetate	(ug/l)	<10
Vinyl chloride	(ug/l)	<0.50
Xylenes	(ug/l)	<1.0

*Present but less than the practical quantitation limits.
cc:

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

LAB NO.: 90-10819
DATE: 05/23/90 dya

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

WATER ANALYSIS
Helena Landfill
HL-9005-102
Sampled 05/03/90 @ 1220
Submitted 05/08/90

#42

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	4.6
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0*
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0*
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0*
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0*
Chloroform	2.8
Bromochloromethane	<1.0
1,1,1-Trichloroethane	0.89
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	5.0
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	2.4

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Bill Peery
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-14925
DATE: 06/18/90 dya

WATER ANALYSIS

Helena Landfill
HL-0690-200
Sampled 06/01/90 @ 1330
Submitted 06/05/90

#48

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0*
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0*
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	1.6
Bromochloromethane	<1.0
1,1,1-Trichloroethane	0.67
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50*
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	1.7
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Bill Peery
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-14926
DATE: 06/18/90 dya

WATER ANALYSIS

Helena Landfill
HL-0690-201
Sampled 06/01/90 @ 1350
Submitted 06/05/90

#51

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	1.8	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0*	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0*	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	2.3	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	0.54	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50*	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	1.7	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12765
Date : 6/21/91

WATER ANALYSIS REPORT
Sample Pt Name : HL-9104-102
Sample Date : 4/ 4/91
Sample Time : 13:30:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone	(ug/l)	<10
Acrolein	(ug/l)	<10
Acrylonitrile	(ug/l)	<10
Benzene	(ug/l)	<0.50
Bromochloromethane	(ug/l)	<1.0
Bromodichloromethane	(ug/l)	<1.0
cis-1,3-Dichloropropene	(ug/l)	<1.0
trans-1,3-Dichloropropene	(ug/l)	<1.0
1,4-Difluorobenzene	(ug/l)	<10
Ethanol	(mg/l)	<10
Ethylbenzene	(ug/l)	<1.0
Ethyl methacrylate	(ug/l)	<10
4-Bromofluorobenzene	(ug/l)	<10
Bromoform	(ug/l)	<1.0
Bromomethane	(ug/l)	<1.0
2-Butanone(Methyl Ethyl Ketone)	(ug/l)	<10
Carbon disulfide	(ug/l)	<10
Carbon Tetrachloride	(ug/l)	<0.50
Chlorobenzene	(ug/l)	<1.0
Dibromochloromethane	(ug/l)	<1.0
Chloroethane	(ug/l)	<1.0
2-Chloroethylvinyl ether	(ug/l)	<10
Chloroform	(ug/l)	4.3
Chloromethane	(ug/l)	<1.0
Dibromomethane	(ug/l)	<1.0
1,4-Dichloro-2-butene	(ug/l)	<10
Dichlorodifluoromethane	(ug/l)	3.2
1,1-Dichloroethane	(ug/l)	<1.0
1,2-Dichloroethane	(ug/l)	<0.50
2-Hexanone	(ug/l)	<10
Iodomethane	(ug/l)	<10
Methylene Chloride	(ug/l)	<1.0
4-Methyl-2-pentanone	(ug/l)	<10
1,1-Dichloroethene	(ug/l)	<0.50
trans-1,2-Dichloroethene	(ug/l)	<1.0

cc:

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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12765
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL-9104-102
Sample Date : 4/ 4/91
Sample Time : 13:30:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene	(ug/l)	<1.0
1,1,2,2-Tetrachloroethane	(ug/l)	<1.0
Toluene	(ug/l)	<1.0
1,1,1-Trichloroethane	(ug/l)	0.60
1,1,2-Trichloroethane	(ug/l)	<1.0
ichloroethene	(ug/l)	<0.50
ichlorofluoromethane	(ug/l)	<1.0*
1,2,3-Trichloropropane	(ug/l)	<1.0
Vinyl acetate	(ug/l)	<10
Vinyl chloride	(ug/l)	<0.50
Xylenes	(ug/l)	<1.0
Tetrachloroethene	(ug/l)	2.2

cc:

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Bill Peery
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-14927
DATE: 06/18/90 dya

WATER ANALYSIS

Helena Landfill
HL-0690-202
Sampled 06/01/90 @ 1450
Submitted 06/05/90
#59

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	1.3
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0*
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0*
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	1.6
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50*
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	1.1
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed i
accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

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LABORATORY REPORT PAGE : 1

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12766
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-103
Sample Date : 4/ 4/91
Sample Time : 14:00:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone	(ug/l)	<10
Acrolein	(ug/l)	<10
Acrylonitrile	(ug/l)	<10
Benzene	(ug/l)	<0.50
Bromochloromethane	(ug/l)	<1.0
Bromodichloromethane	(ug/l)	<1.0
cis-1,3-Dichloropropene	(ug/l)	<1.0
trans-1,3-Dichloropropene	(ug/l)	<1.0
1,4-Difluorobenzene	(ug/l)	<10
Ethanol	(mg/l)	<10
Ethylbenzene	(ug/l)	<1.0
Ethyl methacrylate	(ug/l)	<10
4-Bromofluorobenzene	(ug/l)	<10
Bromoform	(ug/l)	<1.0
Bromomethane	(ug/l)	<1.0
2-Butanone(Methyl Ethyl Ketone)	(ug/l)	<10
Carbon disulfide	(ug/l)	<10
Carbon Tetrachloride	(ug/l)	<0.50
Chlorobenzene	(ug/l)	<1.0
Dibromochloromethane	(ug/l)	<1.0
Chloroethane	(ug/l)	<1.0
2-Chloroethylvinyl ether	(ug/l)	<10
Chloroform	(ug/l)	1.8
Chloromethane	(ug/l)	<1.0
Dibromomethane	(ug/l)	<1.0
1,4-Dichloro-2-butene	(ug/l)	<10
Dichlorodifluoromethane	(ug/l)	2.4
1,1-Dichloroethane	(ug/l)	<1.0
1,2-Dichloroethane	(ug/l)	<0.50
2-Hexanone	(ug/l)	<10
Iodomethane	(ug/l)	<10
Methylene Chloride	(ug/l)	<1.0
4-Methyl-2-pentanone	(ug/l)	<10
1,1-Dichloroethene	(ug/l)	<0.50
trans-1,2-Dichloroethene	(ug/l)	<1.0

cc:

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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12766
Date : 6/21/91

WATER ANALYSIS REPORT
Sample Pt Name : HL9104-103
Sample Date : 4/ 4/91
Sample Time : 14:00:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene	(ug/l)	<1.0
1,1,2,2-Tetrachloroethane	(ug/l)	<1.0
Toluene	(ug/l)	<0.50*
1,1,1-Trichloroethane	(ug/l)	<1.0
1,1,2-Trichloroethane	(ug/l)	<0.50
Trichloroethene	(ug/l)	<1.0*
Trichlorofluoromethane	(ug/l)	<1.0
1,2,3-Trichloropropane	(ug/l)	<10
Vinyl acetate	(ug/l)	<0.50
Vinyl chloride	(ug/l)	<1.0
Xylenes	(ug/l)	1.3
Tetrachloroethene		

cc:

67 DEEP

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Bill Peery
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-14928
DATE: 06/18/90 dya

WATER ANALYSIS

Helena Landfill
HL-0690-203
Sampled 06/01/90 @ 1605
Submitted 06/05/90

#67 Deep

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	<1.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
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LABORATORY REPORT

LAB NO.: 90-14929
DATE: 06/18/90 dya

TO: Hydrometrics
ADDRESS: Bill Peery
2727 Airport Road
Helena, MT 59601

WATER ANALYSIS

Helena Landfill
HL-0690-204
Sampled 06/01/90 @ 1600
Submitted 06/05/90
#67 shallow

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0*
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	1.1
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	0.64
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<0.50
1,4-Dichlorobenzene	<1.0
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed i
accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.

P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12764
Date : 6/21/91

WATER ANALYSIS REPORT
Sample Pt Name : HL9104-101
Sample Date : 4/ 4/91
Sample Time : 12:00:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone	(ug/l)	<10
Acrolein	(ug/l)	<10
Acrylonitrile	(ug/l)	<10
Benzene	(ug/l)	<0.50
Bromochloromethane	(ug/l)	<1.0
Bromodichloromethane	(ug/l)	<1.0
cis-1,3-Dichloropropene	(ug/l)	<1.0
trans-1,3-Dichloropropene	(ug/l)	<1.0
1,4-Difluorobenzene	(ug/l)	<10
Ethanol	(mg/l)	<10
Ethylbenzene	(ug/l)	<1.0
Ethyl methacrylate	(ug/l)	<10
4-Bromofluorobenzene	(ug/l)	<10
Bromoform	(ug/l)	<1.0
Bromomethane	(ug/l)	<1.0
2-Butanone(Methyl Ethyl Ketone)	(ug/l)	<10
Carbon disulfide	(ug/l)	<10
Carbon Tetrachloride	(ug/l)	<0.50
Chlorobenzene	(ug/l)	<1.0
Dibromochloromethane	(ug/l)	<1.0
Chloroethane	(ug/l)	<1.0
2-Chloroethylvinyl ether	(ug/l)	<10
Chloroform	(ug/l)	<1.0
Chloromethane	(ug/l)	<1.0
Dibromomethane	(ug/l)	<1.0
1,4-Dichloro-2-butene	(ug/l)	<10
Dichlorodifluoromethane	(ug/l)	<1.0
1,1-Dichloroethane	(ug/l)	<1.0
1,2-Dichloroethane	(ug/l)	<0.50
2-Hexanone	(ug/l)	<10
Iodomethane	(ug/l)	<10
Methylene Chloride	(ug/l)	<1.0
4-Methyl-2-pentanone	(ug/l)	<10
1,1-Dichloroethene	(ug/l)	<0.50
trans-1,2-Dichloroethene	(ug/l)	<1.0

cc:

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FAX (406) 252-6069 • 1-800-735-6325

LABORATORY REPORT

PAGE : 1

Lab No. : 91-1276A
Date : 5/21/91

WATER ANALYSIS REPORT
Sample ID Name : HE910A-10I
Sample Date : 4/ 4/91
Sample Time : 12:00:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE I-Volatile Organic Constituents
EPA Method 624, Revised 05/21/91

ENERGY LABORATORIES

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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT PAGE : 2

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12764
Date : 6/21/91

WATER ANALYSIS REPORT
Sample Pt Name : HL9104-101
Sample Date : 4/ 4/91
Sample Time : 12:00:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene	(ug/l)	<1.0
1,1,2,2-Tetrachloroethane	(ug/l)	<1.0
Toluene	(ug/l)	<1.0
1,1,1-Trichloroethane	(ug/l)	<0.50
1,1,2-Trichloroethane	(ug/l)	<1.0
[illegible]chloroethene	(ug/l)	<0.50
[illegible]chlorofluoromethane	(ug/l)	<1.0
1,2,3-Trichloropropane	(ug/l)	<1.0
Vinyl acetate	(ug/l)	<10
Vinyl chloride	(ug/l)	<0.50
Xylenes	(ug/l)	<1.0
Tetrachloroethene	(ug/l)	<0.50

cc:

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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15044
DATE: 06/18/90 dya

WATER ANALYSIS
Helena City Landfill
HL-9006-106
Sampled 06/06/90 @ 1245
Submitted 06/07/90

#84

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12768
Date : 6/21/91

WATER ANALYSIS REPORT
Sample Pt Name : HL9104-105
Sample Date : 4/ 5/91
Sample Time : 12:00:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone	(ug/l)	<10
Acrolein	(ug/l)	<10
Acrylonitrile	(ug/l)	<10
Benzene	(ug/l)	<0.50*
Bromochloromethane	(ug/l)	<1.0
Bromodichloromethane	(ug/l)	<1.0
cis-1,3-Dichloropropene	(ug/l)	<1.0
trans-1,3-Dichloropropene	(ug/l)	<1.0
1,4-Difluorobenzene	(ug/l)	<10
Ethanol	(mg/l)	<10
Ethylbenzene	(ug/l)	<1.0
Ethyl methacrylate	(ug/l)	<10
4-Bromofluorobenzene	(ug/l)	<10
Bromoform	(ug/l)	<1.0
Bromomethane	(ug/l)	<1.0
2-Butanone(Methyl Ethyl Ketone)	(ug/l)	<10
Carbon disulfide	(ug/l)	<10
Carbon Tetrachloride	(ug/l)	<0.50
Chlorobenzene	(ug/l)	<1.0
Dibromochloromethane	(ug/l)	<1.0
Chloroethane	(ug/l)	<1.0
2-Chloroethylvinyl ether	(ug/l)	<10
Chloroform	(ug/l)	7.0
Chloromethane	(ug/l)	<1.0
Dibromomethane	(ug/l)	<1.0
1,4-Dichloro-2-butene	(ug/l)	<10
Dichlorodifluoromethane	(ug/l)	11
1,1-Dichloroethane	(ug/l)	3.8
1,2-Dichloroethane	(ug/l)	<0.50
2-Hexanone	(ug/l)	<10
Iodomethane	(ug/l)	<10
Methylene Chloride	(ug/l)	4.2
4-Methyl-2-pentanone	(ug/l)	<10
1,1-Dichloroethene	(ug/l)	<0.50
trans-1,2-Dichloroethene	(ug/l)	<1.0

cc:

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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12768
Date : 6/21/91

WATER ANALYSIS REPORT
Sample Pt Name : HL9104-105
Sample Date : 4/ 5/91
Sample Time : 12:00:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene	(ug/l)	<1.0
1,1,2,2-Tetrachloroethane	(ug/l)	<1.0
Toluene	(ug/l)	<1.0
1,1,1-Trichloroethane	(ug/l)	<0.50
1,1,2-Trichloroethane	(ug/l)	<1.0
Trichloroethene	(ug/l)	7.4
Trichlorofluoromethane	(ug/l)	4.3
1,2,3-Trichloropropane	(ug/l)	<1.0
Vinyl acetate	(ug/l)	<10
Vinyl chloride	(ug/l)	<0.50
Xylenes	(ug/l)	<1.0
Tetrachloroethene	(ug/l)	66

cc:

MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES

LAB. NO. 005550

Public Health Lab, W.F. Cogswell Building, Helena, Montana 59620
Phone: 444-2642

Received 11-14-89 Reported 11-14-89

SAMPLING PROCEDURE:

1. Remove screen. Allow water to run 2 - 3 minutes.
2. Fill bottle or bag to 3/4 full — without touching inside. Do not rinse out bottle/bag.
3. Fill out sampling information below and return to lab within 48 hours.
4. **Enclose $6.50 check or money order to cover cost. Results will not be sent until fee is paid.**

DATE Collected 11-13-89 Time 1130

Owner of Water Source Helena Land Fill (MW-1)

Location of Water Source Helena, MT
Nearest City

County _____

Type of Supply *(Circle One)* Cistern Well Spring River Monitoring
Other
(Please Specify)

Collector of Sample: N. Pratt Phone No. 443-4150

Person to Receive Report *(Please Print)*:

NAME: Hydrometrics - Randy McAmis

Street or RFD: 2727 Airport rd

City: Helena MT Zip: 59601

DO NOT WRITE BELOW THIS LINE

TOTAL COLIFORM
5+
Multiple Tube *Membrane Filter*

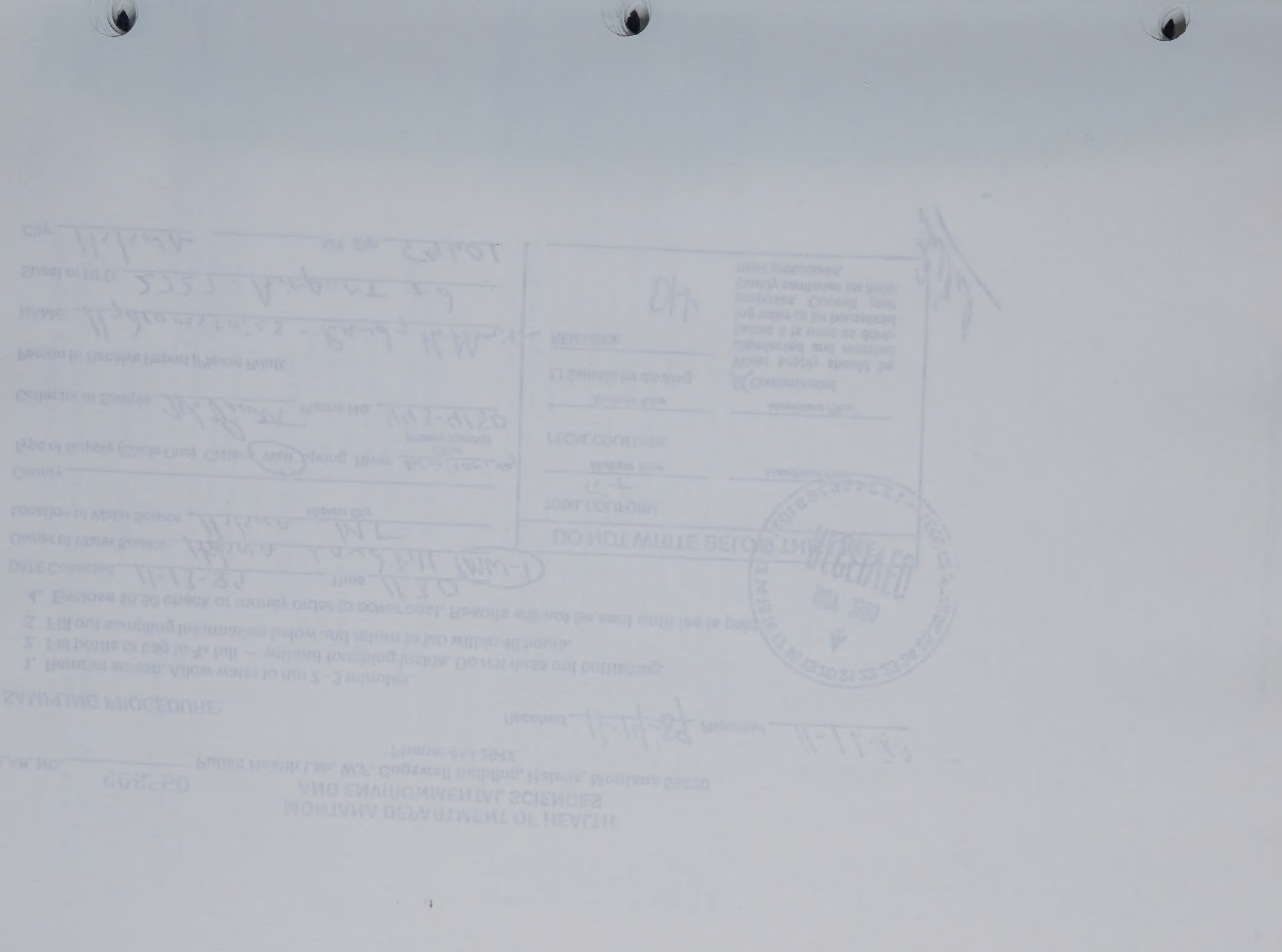
FECAL COLIFORM
Multiple Tube *Membrane Filter*

☐ Suitable for drinking.

☒ Contaminated
Water supply should be disinfected and retested before it is used as drinking water or for household purposes. Consult your county sanitarian for treatment procedures.

REMARKS:

RECEIVED
NOV 1989



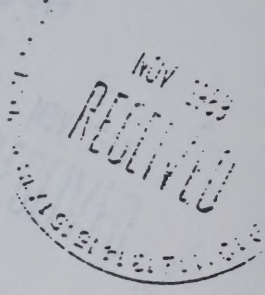
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P O BOX 30916 • 1167 SOUTH BROADWAY • BILLINGS MT 59107-0916 • PHONE (406) 252-6325
800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59601

LAB NO.: 89-20185
DATE: 11/27/89 dya

#1MW



WATER ANALYSIS
Helena Landfill
HL-8911-006
Sampled 11/13/89 @ 1130
Submitted 11/14/89

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	3.5	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50*	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0*	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA method 502.2

*Present but less than the practical quantitation limit.

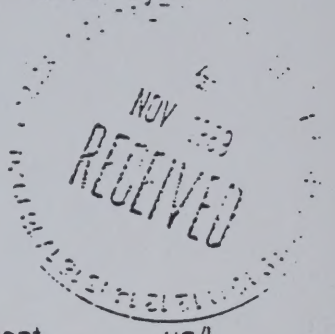
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800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59601

LAB NO.: 89-20182
DATE: 11/27/89 dya

#7mw



WATER ANALYSIS
Helena Landfill
HL-8911-003
Sampled 11/11/89 @ 1755
Submitted 11/14/89

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	16	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0*	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	1.7	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	5.8	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	2.3	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	7.1	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	3.5	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	4.5	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	6.3

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
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FAX (406) 252-6069 • 1-800-873-5227

GOLF COURSE POND

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-10828
DATE: 05/23/90 dya

WATER ANALYSIS

Helena Landfill
HL-9005-111
Sampled 05/06/90 @ 1135
Submitted 05/08/90

POND ON GOLF COURSE

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-7837
DATE: 04/27/90 dya

WATER ANALYSIS

City of Helena
HL-9004-101
Sampled 04/03/90 @ 1115
Submitted 04/11/90
Golf Course well #1

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	1.9	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	1.4	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	1.9	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0*	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	0.96	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	1.5	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed i
accordance with EPA method 524.2.

*Present but less than the practical quantitation limit.

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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

To : Hydrometrics
Address : Attn: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

Lab No. : 90-7837
Date : 4/27/90

WATER ANALYSIS REPORT

Sample Pt Name : HL-9004-101
Sample Date : 4/ 3/90
Sample Time : 11:15:00
Sample Received : 4/11/90
City of Helena
Golf Course well #1

LABORATORY DATA:		
Potassium, Dissolved	(mg/l)	3
Sodium, Dissolved	(mg/l)	43
Calcium, Dissolved	(mg/l)	85
Magnesium, Dissolved	(mg/l)	26
Sulfate as SO4	(mg/l)	104
Chloride	(mg/l)	35
Carbonate as CO3	(mg/l)	0
Bicarbonate as HCO3	(mg/l)	302
Total Hardness as CaCO3	(mg/l)	321
Conductivity, @ 25 degrees C	(umhos/cm)	767
pH @ 25 degrees C, s.u.	(s.u.)	7.4
Nitrate + Nitrite as N	(mg/l)	4.70
Cadmium, Dissolved	(mg/l)	<0.001
Copper, Dissolved	(mg/l)	<0.01
Lead, Dissolved	(mg/l)	<0.01
Iron, Dissolved	(mg/l)	<0.03
Zinc, Dissolved	(mg/l)	0.02

cc:

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GOLF COURSE

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-12196
DATE: 05/30/90 dya



WATER ANALYSIS
Helena Landfill
HL-9005-116
Sampled 05/08/90 @ 1140
Submitted 05/15/90
Golf Course well #3

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	5.2	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0*	Styrene	<1.0
1,1-Dichloroethene	<0.50*	Bromoform	<1.0
Methylene Chloride	1.1	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	1.7	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	1.1	n-Propylbenzene	<1.0
Chloroform	3.8	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	2.6	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	1.1	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	7.0	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	3.9

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

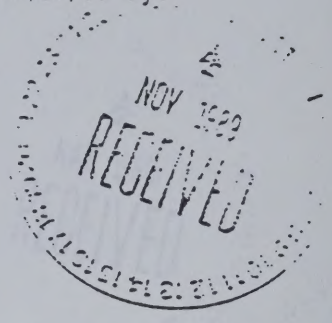
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800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59601

LAB NO.: 89-20181
DATE: 11/27/89 dya

82-2



WATER ANALYSIS
Helena Landfill
HL-8911-002
Sampled 11/11/89 @ 1715
Submitted 11/14/89

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed accordance with EPA method 502.2

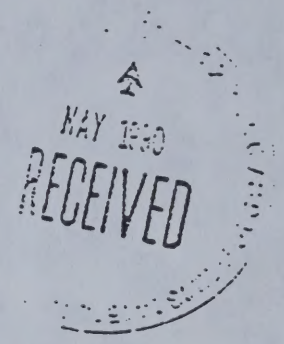
*Present but less than the practical quantitation limit.

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-12199
DATE: 05/30/90 dya



WATER ANALYSIS

Helena Landfill
HL-9005-122
Sampled 05/11/90 @ 1530
Submitted 05/15/90
82-4

EPA METHOD 625:

Acid Extractables	µg/l		µg/l
4-Chloro-3-methylphenol	<10	2-Nitrophenol	<10
2-Chlorophenol	<10	4-Nitrophenol	<50
2,4-Dichlorophenol	<10	Pentachlorophenol	<50
2,4-Dimethylphenol	<10	Phenol	<10
2,4-Dinitrophenol	<50	2,4,6-Trichlorophenol	<10
2-Methyl-4,6-dinitrophenol	<50		

Base Neutral Extractables	µg/l		µg/l
Acenaphthene	<10	3,3-Dichlorobenzidine	<10
Acenaphthylene	<10	Diethyl phthalate	<10
Anthracene	<10	Dimethyl phthalate	<10
Azobenzene	<10	Di-n-butyl phthalate	<10
Benzidine	<10	2,4-Dinitrotoluene	<10
Benzo(a)anthracene	<10	2,6-Dinitrotoluene	<10
Benzo(a)pyrene	<10	Di-n-octyl phthalate	<10
Benzo(b)fluoranthene	<10	Fluoranthene	<10
Benzo(k)fluoranthene	<10	Fluorene	<10
Benzo(ghi)perylene	<10	Hexachlorobenzene	<10
Bis(2-chloroethoxy)methane	<10	Hexachlorobutadiene	<10
Bis(2-chloroethyl)ether	<10	Hexachloroethane	<10
Bis(2-chloroisopropyl)ether	<10	Indeno (1,2,3-cd)pyrene	<10
Bis(2-ethylhexyl)phthalate	<10	Isophorone	<10
4-Bromophenylphenyl ether	<10	Naphthalene	<10
Butyl benzyl phthalate	<10	Nitrobenzene	<10
2-Chloronaphthalene	<10	N-Nitrosophenylamine	<10
4-Chlorophenylphenyl ether	<10	N-Nitrosodi-n-propylamine	<10
Chrysene	<10	Phenanthrene	<10
Dibenzo(a,h)anthracene	<10	Pyrene	<10
1,2-Dichlorobenzene	<10	1,2,4-Trichlorobenzene	<10
1,3-Dichlorobenzene	<10		
1,4-Dichlorobenzene	<10		

ENERGY LABORATORIES, INC.
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800-873-5227

82-4 DUP

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59601

82-4

LAB NO.: 89-20180 dup
DATE: 11/27/89 dya



QUALITY ASSURANCE - DUPLICATE ANALYSIS

Helena Landfill
HL-8911-001
Sampled 11/11/89 @ 1530
Submitted 11/14/89

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	67	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	40	Styrene	<1.0
1,1-Dichloroethene	<0.50*	Bromoform	<1.0
Methylene Chloride	7.5	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	2.4	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0*	n-Propylbenzene	<1.0
Chloroform	<1.0*	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	9.8	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	2.9	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	4.8	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	33

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA method 502.2

*Present but less than the practical quantitation limit.

ENERGY LABORATORIES, INC.
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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12769
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-106
Sample Date : 4/ 5/91
Sample Time : 14:00:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:		
Acetone	(ug/l)	<10
Acrolein	(ug/l)	<10
Acrylonitrile	(ug/l)	<10
Benzene	(ug/l)	<0.50
Bromochloromethane	(ug/l)	<1.0
Bromodichloromethane	(ug/l)	<1.0
cis-1,3-Dichloropropene	(ug/l)	<1.0
trans-1,3-Dichloropropene	(ug/l)	<1.0
1,4-Difluorobenzene	(ug/l)	<10
Ethanol	(mg/l)	<10
Ethylbenzene	(ug/l)	<1.0
Ethyl methacrylate	(ug/l)	<10
4-Bromofluorobenzene	(ug/l)	<10
Bromoform	(ug/l)	<1.0
Bromomethane	(ug/l)	<1.0
2-Butanone(Methyl Ethyl Ketone)	(ug/l)	<10
Carbon disulfide	(ug/l)	<10
Carbon Tetrachloride	(ug/l)	<0.50
Chlorobenzene	(ug/l)	<1.0
Dibromochloromethane	(ug/l)	<1.0
Chloroethane	(ug/l)	<1.0
2-Chloroethylvinyl ether	(ug/l)	<10
Chloroform	(ug/l)	3.2
Chloromethane	(ug/l)	<1.0
Dibromomethane	(ug/l)	<1.0
1,4-Dichloro-2-butene	(ug/l)	<10
Dichlorodifluoromethane	(ug/l)	<1.0
1,1-Dichloroethane	(ug/l)	<1.0
1,2-Dichloroethane	(ug/l)	<0.50
2-Hexanone	(ug/l)	<10
Iodomethane	(ug/l)	<10
Methylene Chloride	(ug/l)	<1.0
4-Methyl-2-pentanone	(ug/l)	<10
1,1-Dichloroethene	(ug/l)	<0.50
trans-1,2-Dichloroethene	(ug/l)	<1.0

CC:

ENERGY LABORATORIES, INC.
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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12769
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-106
Sample Date : 4/ 5/91
Sample Time : 14:00:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:		
Styrene	(ug/l)	<1.0
1,1,2,2-Tetrachloroethane	(ug/l)	<1.0
Toluene	(ug/l)	<1.0
1,1,1-Trichloroethane	(ug/l)	2.9
1,1,2-Trichloroethane	(ug/l)	<1.0
[illegible]ichloroethene	(ug/l)	<0.50
[illegible]richlorofluoromethane	(ug/l)	<1.0
1,2,3-Trichloropropane	(ug/l)	<1.0
Vinyl acetate	(ug/l)	<10
Vinyl chloride	(ug/l)	<0.50
Xylenes	(ug/l)	<1.0
Tetrachloroethene	(ug/l)	<0.50

cc:

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-12769
Date : 4/24/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-106
Sample Date : 4/ 5/91
Sample Time : 14:00:00
Sample Received : 4/ 9/91
Helena Landfill

LABORATORY DATA:

Potassium, Dissolved	(mg/l)	5
Sodium, Dissolved	(mg/l)	23
Calcium, Dissolved	(mg/l)	114
Magnesium, Dissolved	(mg/l)	31
Sulfate as SO4	(mg/l)	109
Chloride	(mg/l)	32
Carbonate as CO3	(mg/l)	0
Bicarbonate as HCO3	(mg/l)	311
Solids, Dissolved @ 180 degrees C	(mg/l)	511
Alkalinity, Total as CaCO3, pH 4.5	(mg/l)	255
pH @ 25 degrees C, s.u.	(s.u.)	7.5
Nitrate + Nitrite as N	(mg/l)	8.91
Nitrogen, Ammonia	(mg/l)	<0.1
Chemical Oxygen Demand	(mg/l)	<1
Organic Carbon, Total	(mg/l)	<2
Cyanide, Total	(mg/l)	<0.005
Arsenic, Dissolved	(mg/l)	<0.005
Barium, Dissolved	(mg/l)	<0.1
Cadmium, Dissolved	(mg/l)	<0.001
Chromium, Dissolved	(mg/l)	<0.02
Iron, Dissolved	(mg/l)	<0.03
Lead, Dissolved	(mg/l)	<0.01
Manganese, Dissolved	(mg/l)	0.04
Mercury, Dissolved	(mg/l)	<0.001
Selenium, Dissolved	(mg/l)	<0.005
Silver, Dissolved	(mg/l)	<0.005

cc:

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800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59601

LAB NO.: 89-20183
DATE: 11/27/89 dya

83-7

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WATER ANALYSIS
Helena Landfill
HL-8911-004
Sampled 11/11/89 @ 1855
Submitted 11/14/89

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0*	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0*	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0*	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	4.4	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA method 502.2

*Present but less than the practical quantitation limit.

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800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-2766
DATE: 02/09/90 dya

WATER ANALYSIS

Helena Landfill
HL90-2-101
Sampled 02/02/90 @ 1615
Submitted 02/06/90

HL90-1

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Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	15.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50*	Bromoform	<1.0
Methylene Chloride	3.6	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	2.6	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0*	n-Propylbenzene	<1.0
Chloroform	3.5	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	7.4	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	0.58	p-Isopropyltoluene	<1.0
Trichloroethene	1.5	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	13.0	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	6.9

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed accordance with EPA method 502.2.

*Present but less than the practical quantitation limit.

HL-90-1

ENERGY LABORATORIES, INC.
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800-873-5227

LABORATORY REPORT

To : Hydrometrics
Address : Attn: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

Lab No. : 90-2766
Date : 2/12/90

WATER ANALYSIS REPORT
Sample Pt Name : HL90-2-101
Sample Date : 2/ 2/90
Sample Time : 16:15:00
Sample Received : 2/ 6/90
Helena Landfill
HL90-1

LABORATORY DATA:		
Potassium, Dissolved	(mg/l)	3
Sodium, Dissolved	(mg/l)	35
Calcium, Dissolved	(mg/l)	137
Magnesium, Dissolved	(mg/l)	45
Sulfate as SO4	(mg/l)	132
Chloride	(mg/l)	31
Carbonate as CO3	(mg/l)	0
arbonate as HCO3	(mg/l)	482
ids, Dissolved @ 180 degrees C	(mg/l)	685
al Hardness as CaCO3	(mg/l)	528
Alkalinity, Total as CaCO3, pH 4.5	(mg/l)	395
Conductivity, @ 25 degrees C	(umhos/cm)	1100
pH @ 25 degrees C, s.u.	(s.u.)	7.8
Nitrate + Nitrite as N	(mg/l)	8.40
Cadmium, Dissolved	(mg/l)	0.005
Copper, Dissolved	(mg/l)	<0.01
Iron, Dissolved	(mg/l)	<0.03
Lead, Dissolved	(mg/l)	<0.01
Zinc, Dissolved	(mg/l)	0.02

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-12198
DATE: 05/30/90 dya

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WATER ANALYSIS

Helena Landfill
HL-9005-121
Sampled 05/11/90 @ 1110
Submitted 05/15/90

HL-90-1

EPA METHOD 625:

Acid Extractables	µg/l		µg/l
4-Chloro-3-methylphenol	<10	2-Nitrophenol	<10
2-Chlorophenol	<10	4-Nitrophenol	<50
2,4-Dichlorophenol	<10	Pentachlorophenol	<50
2,4-Dimethylphenol	<10	Phenol	<10
2,4-Dinitrophenol	<50	2,4,6-Trichlorophenol	<10
2-Methyl-4,6-dinitrophenol	<50		

Base Neutral Extractables	µg/l		µg/l
Acenaphthene	<10	3,3-Dichlorobenzidine	<10
Acenaphthylene	<10	Diethyl phthalate	<10
Anthracene	<10	Dimethyl phthalate	<10
Azobenzene	<10	Di-n-butyl phthalate	<10
Benzidine	<10	2,4-Dinitrotoluene	<10
Benzo(a)anthracene	<10	2,6-Dinitrotoluene	<10
Benzo(a)pyrene	<10	Di-n-octyl phthalate	<10
Benzo(b)fluoranthene	<10	Fluoranthene	<10
Benzo(k)fluoranthene	<10	Fluorene	<10
Benzo(ghi)perylene	<10	Hexachlorobenzene	<10
Bis(2-chloroethoxy)methane	<10	Hexachlorobutadiene	<10
Bis(2-chloroethyl)ether	<10	Hexachloroethane	<10
Bis(2-chloroisopropyl)ether	<10	Indeno (1,2,3-cd)pyrene	<10
Bis(2-ethylhexyl)phthalate	<10	Isophorone	<10
4-Bromophenylphenyl ether	<10	Naphthalene	<10
Butyl benzyl phthalate	<10	Nitrobenzene	<10
2-Chloronaphthalene	<10	N-Nitrosophenylamine	<10
4-Chlorophenylphenyl ether	<10	N-Nitrosodi-n-propylamine	<10
Chrysene	<10	Phenanthrene	<10
Dibenzo(a,h)anthracene	<10	Pyrene	<10
1,2-Dichlorobenzene	<10	1,2,4-Trichlorobenzene	<10
1,3-Dichlorobenzene	<10		
1,4-Dichlorobenzene	<10		

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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12771
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-108
Sample Date : 4/ 5/91
Sample Time : 15:30:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone	(ug/l)	<10
Acrolein	(ug/l)	<10
Acrylonitrile	(ug/l)	<10
Benzene	(ug/l)	<0.50
Bromochloromethane	(ug/l)	<1.0
Bromodichloromethane	(ug/l)	<1.0
cis-1,3-Dichloropropene	(ug/l)	<1.0
trans-1,3-Dichloropropene	(ug/l)	<1.0
1,4-Difluorobenzene	(ug/l)	<10
Ethanol	(mg/l)	<10
Ethylbenzene	(ug/l)	<1.0
Ethyl methacrylate	(ug/l)	<10
4-Bromofluorobenzene	(ug/l)	<10
Bromoform	(ug/l)	<1.0
Bromomethane	(ug/l)	<1.0
2-Butanone(Methyl Ethyl Ketone)	(ug/l)	<10
Carbon disulfide	(ug/l)	<10
Carbon Tetrachloride	(ug/l)	<0.50
Chlorobenzene	(ug/l)	<1.0
Dibromochloromethane	(ug/l)	<1.0
Chloroethane	(ug/l)	<1.0
2-Chloroethylvinyl ether	(ug/l)	<10
Chloroform	(ug/l)	4.1
Chloromethane	(ug/l)	<1.0
Dibromomethane	(ug/l)	<1.0
1,4-Dichloro-2-butene	(ug/l)	<10
Dichlorodifluoromethane	(ug/l)	8.9
1,1-Dichloroethane	(ug/l)	2.9
1,2-Dichloroethane	(ug/l)	0.50
2-Hexanone	(ug/l)	<10
Iodomethane	(ug/l)	<10
Methylene Chloride	(ug/l)	3.6
4-Methyl-2-pentanone	(ug/l)	<10
1,1-Dichloroethene	(ug/l)	<0.50*
trans-1,2-Dichloroethene	(ug/l)	<1.0

cc:

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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12771
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-108
Sample Date : 4/ 5/91
Sample Time : 15:30:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene	(ug/l)	<1.0
1,1,2,2-Tetrachloroethane	(ug/l)	<1.0
Toluene	(ug/l)	<1.0
1,1,1-Trichloroethane	(ug/l)	7.0
1,1,2-Trichloroethane	(ug/l)	<1.0
[illegible]hloroethene	(ug/l)	2.2
[illegible]hlorofluoromethane	(ug/l)	2.8
1,2,3-Trichloropropane	(ug/l)	<1.0
Vinyl acetate	(ug/l)	<10
Vinyl chloride	(ug/l)	<0.50
Xylenes	(ug/l)	<1.0
Tetrachloroethene	(ug/l)	12

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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-12771
Date : 4/24/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-108
Sample Date : 4/ 5/91
Sample Time : 15:30:00
Sample Received : 4/ 9/91
Helena Landfill

LABORATORY DATA:

Potassium, Dissolved	(mg/l)	5
Sodium, Dissolved	(mg/l)	38
Calcium, Dissolved	(mg/l)	144
Magnesium, Dissolved	(mg/l)	48
Sulfate as SO4	(mg/l)	140
Chloride	(mg/l)	33
Carbonate as CO3	(mg/l)	0
Bicarbonate as HCO3	(mg/l)	491
Solids, Dissolved @ 180 degrees C	(mg/l)	687
Alkalinity, Total as CaCO3, pH 4.5	(mg/l)	402
pH @ 25 degrees C, s.u.	(s.u.)	7.7
Nitrate + Nitrite as N	(mg/l)	7.53
Nitrogen, Ammonia	(mg/l)	<0.1
Chemical Oxygen Demand	(mg/l)	2
Organic Carbon, Total	(mg/l)	<2
Cyanide, Total	(mg/l)	<0.005
Arsenic, Dissolved	(mg/l)	<0.005
Barium, Dissolved	(mg/l)	<0.1
Cadmium, Dissolved	(mg/l)	0.001
Chromium, Dissolved	(mg/l)	<0.02
Iron, Dissolved	(mg/l)	<0.03
Lead, Dissolved	(mg/l)	<0.01
Manganese, Dissolved	(mg/l)	<0.02
Mercury, Dissolved	(mg/l)	<0.001
Selenium, Dissolved	(mg/l)	<0.005
Silver, Dissolved	(mg/l)	<0.005

cc:

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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12772
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-118
Sample Date : 4/ 5/91
Sample Time : 16:00:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone	(ug/l)	<10
Acrolein	(ug/l)	<10
Acrylonitrile	(ug/l)	<10
Benzene	(ug/l)	<0.50
Bromochloromethane	(ug/l)	<1.0
Bromodichloromethane	(ug/l)	<1.0
cis-1,3-Dichloropropene	(ug/l)	<1.0
trans-1,3-Dichloropropene	(ug/l)	<1.0
1,4-Difluorobenzene	(ug/l)	<10
Ethanol	(ug/l)	<10
Ethylbenzene	(ug/l)	<1.0
Ethyl methacrylate	(ug/l)	<10
4-Bromofluorobenzene	(ug/l)	<10
Bromoform	(ug/l)	<1.0
Bromomethane	(ug/l)	<1.0
2-Butanone(Methyl Ethyl Ketone)	(ug/l)	<10
Carbon disulfide	(ug/l)	<10
Carbon Tetrachloride	(ug/l)	<0.50
Chlorobenzene	(ug/l)	<1.0
Dibromochloromethane	(ug/l)	<1.0
Chloroethane	(ug/l)	<1.0
2-Chloroethylvinyl ether	(ug/l)	<10
Chloroform	(ug/l)	3.9
Chloromethane	(ug/l)	<1.0
Dibromomethane	(ug/l)	<1.0
1,4-Dichloro-2-butene	(ug/l)	<10
Dichlorodifluoromethane	(ug/l)	8.8
1,1-Dichloroethane	(ug/l)	2.8
1,2-Dichloroethane	(ug/l)	0.50
2-Hexanone	(ug/l)	<10
Iodomethane	(ug/l)	<10
Methylene Chloride	(ug/l)	3.5
4-Methyl-2-pentanone	(ug/l)	<10
1,1-Dichloroethene	(ug/l)	<0.50*
trans-1,2-Dichloroethene	(ug/l)	<1.0

cc:

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FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12772
Date : 6/21/91

WATER ANALYSIS REPORT
Sample Pt Name : HL9104-118
Sample Date : 4/ 5/91
Sample Time : 16:00:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene	(ug/l)	<1.0
1,1,2,2-Tetrachloroethane	(ug/l)	<1.0
Toluene	(ug/l)	<1.0
1,1,1-Trichloroethane	(ug/l)	6.6
1,1,2-Trichloroethane	(ug/l)	<1.0
[illegible]chloroethene	(ug/l)	2.2
[illegible]chlorofluoromethane	(ug/l)	2.6
1,2,3-Trichloropropane	(ug/l)	<1.0
Vinyl acetate	(ug/l)	<10
Vinyl chloride	(ug/l)	<0.50
Xylenes	(ug/l)	<1.0
Tetrachloroethene	(ug/l)	13

cc:

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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-12772
Date : 4/24/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-118
Sample Date : 4/ 5/91
Sample Time : 16:00:00
Sample Received : 4/ 9/91
Helena Landfill

LABORATORY DATA:

Potassium, Dissolved	(mg/l)	4
Sodium, Dissolved	(mg/l)	37
Calcium, Dissolved	(mg/l)	145
Magnesium, Dissolved	(mg/l)	48
Sulfate as SO4	(mg/l)	141
Chloride	(mg/l)	33
Carbonate as CO3	(mg/l)	0
Bicarbonate as HCO3	(mg/l)	487
Solids, Dissolved @ 180 degrees C	(mg/l)	678
Alkalinity, Total as CaCO3, pH 4.5	(mg/l)	399
pH @ 25 degrees C, s.u.	(s.u.)	7.6

cc:

ENERGY LABORATORIES, INC.
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800-873-5227

LABORATORY REPORT

LAB NO.: 90-2767
DATE: 02/09/90 dya

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

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WATER ANALYSIS

Helena Landfill
HL90-2-102
Sampled 02/03/90 @ 1245
Submitted 02/06/90

HL90-2

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	5.6	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0*	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	2.9	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0*	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	2.0	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50*	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	3.4

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA method 502.2.

*Present but less than the practical quantitation limit.

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LABORATORY REPORT PAGE : 1

To : Hydrometrics
Address : Attn: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

Lab No. : 90-2767
Date : 2/12/90

WATER ANALYSIS REPORT
Sample Pt Name : HL90-2-102
Sample Date : 2/ 3/90
Sample Time : 12:45:00
Sample Received : 2/ 6/90
Helena Landfill

HL90-2

LABORATORY DATA:

Potassium, Dissolved	(mg/l)	3
Sodium, Dissolved	(mg/l)	23
Calcium, Dissolved	(mg/l)	121
Magnesium, Dissolved	(mg/l)	35
Sulfate as SO4	(mg/l)	62
Chloride	(mg/l)	32
Carbonate as CO3	(mg/l)	0
Bicarbonate as HCO3	(mg/l)	448
ids, Dissolved @ 180 degrees C	(mg/l)	511
:al Hardness as CaCO3	(mg/l)	444
kalinity, Total as CaCO3, pH 4.5	(mg/l)	367
Conductivity, @ 25 degrees C	(umhos/cm)	877
pH @ 25 degrees C, s.u.	(s.u.)	7.9
Nitrate + Nitrite as N	(mg/l)	0.90
Cadmium, Dissolved	(mg/l)	0.005
Copper, Dissolved	(mg/l)	<0.01
Iron, Dissolved	(mg/l)	0.06
Lead, Dissolved	(mg/l)	<0.01
Zinc, Dissolved	(mg/l)	0.02

cc:

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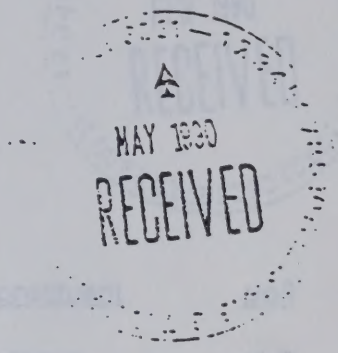
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HL-90-2

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-12197
DATE: 05/30/90 dya



WATER ANALYSIS

Helena Landfill
HL-9005-120
Sampled 05/10/90 @ 1640
Submitted 05/15/90

HL90-2

EPA METHOD 625:

Acid Extractables	µg/l		µg/l
4-Chloro-3-methylphenol	<10	2-Nitrophenol	<10
2-Chlorophenol	<10	4-Nitrophenol	<50
2,4-Dichlorophenol	<10	Pentachlorophenol	<50
2,4-Dimethylphenol	<10	Phenol	<10
2,4-Dinitrophenol	<50	2,4,6-Trichlorophenol	<10
2-Methyl-4,6-dinitrophenol	<50		

Base Neutral Extractables	µg/l		µg/l
Acenaphthene	<10	3,3-Dichlorobenzidine	<10
Acenaphthylene	<10	Diethyl phthalate	<10
Anthracene	<10	Dimethyl phthalate	<10
Azobenzene	<10	Di-n-butyl phthalate	<10
Benzidine	<10	2,4-Dinitrotoluene	<10
Benzo(a)anthracene	<10	2,6-Dinitrotoluene	<10
Benzo(a)pyrene	<10	Di-n-octyl phthalate	<10
Benzo(b)fluoranthene	<10	Fluoranthene	<10
Benzo(k)fluoranthene	<10	Fluorene	<10
Benzo(ghi)perylene	<10	Hexachlorobenzene	<10
Bis(2-chloroethoxy)methane	<10	Hexachlorobutadiene	<10
Bis(2-chloroethyl)ether	<10	Hexachloroethane	<10
Bis(2-chloroisopropyl)ether	<10	Indeno (1,2,3-cd)pyrene	<10
Bis(2-ethylhexyl)phthalate	<10	Isophorone	<10
4-Bromophenylphenyl ether	<10	Naphthalene	<10
Butyl benzyl phthalate	<10	Nitrobenzene	<10
2-Chloronaphthalene	<10	N-Nitrosophenylamine	<10
4-Chlorophenylphenyl ether	<10	N-Nitrosodi-n-propylamine	<10
Chrysene	<10	Phenanthrene	<10
Dibenzo(a,h)anthracene	<10	Pyrene	<10
1,2-Dichlorobenzene	<10	1,2,4-Trichlorobenzene	<10
1,3-Dichlorobenzene	<10		
1,4-Dichlorobenzene	<10		

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-2765
DATE: 02/09/90 dya

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WATER ANALYSIS

Helena Landfill
HL90-2-100
Sampled 02/02/90 @ 1430
Submitted 02/06/90

HL90-3

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	1.3	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0*	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	1.1	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	1.8	n-Propylbenzene	<1.0
Chloroform	5.5	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	<0.50	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	0.60	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	<1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	2.6	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0
		Dichloromonofluoromethane	<1.0*

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA method 502.2.

*Present but less than the practical quantitation limit.

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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12767
Date : 6/21/91

WATER ANALYSIS REPORT
Sample Pt Name : HL9104-104
Sample Date : 4/ 4/91
Sample Time : 16:00:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Acetone	(ug/l)	<10
Acrolein	(ug/l)	<10
Acrylonitrile	(ug/l)	<10
Benzene	(ug/l)	<0.50
Bromochloromethane	(ug/l)	<1.0
Bromodichloromethane	(ug/l)	<1.0
cis-1,3-Dichloropropene	(ug/l)	<1.0
trans-1,3-Dichloropropene	(ug/l)	<1.0
1,4-Difluorobenzene	(ug/l)	<10
Ethanol	(mg/l)	<10
Ethylbenzene	(ug/l)	<1.0
Ethyl methacrylate	(ug/l)	<10
4-Bromofluorobenzene	(ug/l)	<10
Bromoform	(ug/l)	<1.0
Bromomethane	(ug/l)	<1.0
2-Butanone(Methyl Ethyl Ketone)	(ug/l)	<10
Carbon disulfide	(ug/l)	<10
Carbon Tetrachloride	(ug/l)	<0.50
Chlorobenzene	(ug/l)	<1.0
Dibromochloromethane	(ug/l)	<1.0
Chloroethane	(ug/l)	<1.0
2-Chloroethylvinyl ether	(ug/l)	<10
Chloroform	(ug/l)	<1.0
Chloromethane	(ug/l)	<1.0
Dibromomethane	(ug/l)	<1.0
1,4-Dichloro-2-butene	(ug/l)	<10
Dichlorodifluoromethane	(ug/l)	<1.0*
1,1-Dichloroethane	(ug/l)	2.2
1,2-Dichloroethane	(ug/l)	<0.50
2-Hexanone	(ug/l)	<10
Iodomethane	(ug/l)	<10
Methylene Chloride	(ug/l)	<1.0*
4-Methyl-2-pentanone	(ug/l)	<10
1,1-Dichloroethene	(ug/l)	<0.50
trans-1,2-Dichloroethene	(ug/l)	<1.0

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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12767
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-104
Sample Date : 4/ 4/91
Sample Time : 16:00:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene	(ug/l)	<1.0
1,1,2,2-Tetrachloroethane	(ug/l)	<1.0
Toluene	(ug/l)	<1.0
1,1,1-Trichloroethane	(ug/l)	1.0
1,1,2-Trichloroethane	(ug/l)	<1.0
Trichloroethene	(ug/l)	<0.50
Trichlorofluoromethane	(ug/l)	<1.0
1,2,3-Trichloropropane	(ug/l)	<1.0
Vinyl acetate	(ug/l)	<10
Vinyl chloride	(ug/l)	<0.50
Xylenes	(ug/l)	<1.0
Tetrachloroethene	(ug/l)	<0.50

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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-12767
Date : 4/24/91

WATER ANALYSIS REPORT
Sample Pt Name : HL9104-104
Sample Date : 4/ 4/91
Sample Time : 16:00:00
Sample Received : 4/ 9/91
Helena Landfill

LABORATORY DATA:

Potassium, Dissolved	(mg/l)	3
Sodium, Dissolved	(mg/l)	25
Calcium, Dissolved	(mg/l)	116
Magnesium, Dissolved	(mg/l)	33
Sulfate as SO4	(mg/l)	61
Chloride	(mg/l)	31
Carbonate as CO3	(mg/l)	0
Bicarbonate as HCO3	(mg/l)	428
Solids, Dissolved @ 180 degrees C	(mg/l)	489
Alkalinity, Total as CaCO3, pH 4.5	(mg/l)	351
pH @ 25 degrees C, s.u.	(s.u.)	7.8
Nitrate + Nitrite as N	(mg/l)	0.83
Nitrogen, Ammonia	(mg/l)	<0.1
Chemical Oxygen Demand	(mg/l)	<1
Organic Carbon, Total	(mg/l)	2
Cyanide, Total	(mg/l)	<0.005
Arsenic, Dissolved	(mg/l)	<0.005
Barium, Dissolved	(mg/l)	<0.1
Cadmium, Dissolved	(mg/l)	0.001
Chromium, Dissolved	(mg/l)	<0.02
Iron, Dissolved	(mg/l)	0.12
Lead, Dissolved	(mg/l)	<0.01
Manganese, Dissolved	(mg/l)	<0.02
Mercury, Dissolved	(mg/l)	<0.001
Selenium, Dissolved	(mg/l)	<0.005
Silver, Dissolved	(mg/l)	<0.005

cc:

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LABORATORY REPORT PAGE : 1

To : Hydrometrics
Address : Attn: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

Lab No. : 90-2765
Date : 2/12/90

WATER ANALYSIS REPORT
Sample Pt Name : HL90-2-100
Sample Date : 2/ 2/90
Sample Time : 14:30:00
Sample Received : 2/ 6/90
Helena Landfill

HL90-3

LABORATORY DATA:		
Potassium, Dissolved	(mg/l)	3
Sodium, Dissolved	(mg/l)	80
Calcium, Dissolved	(mg/l)	109
Magnesium, Dissolved	(mg/l)	40
Sulfate as SO4	(mg/l)	136
Chloride	(mg/l)	30
Carbonate as CO3	(mg/l)	0
Bicarbonate as HCO3	(mg/l)	488
Solids, Dissolved @ 180 degrees C	(mg/l)	686
Total Hardness as CaCO3	(mg/l)	435
Alkalinity, Total as CaCO3, pH 4.5	(mg/l)	400
Conductivity, @ 25 degrees C	(umhos/cm)	1130
pH @ 25 degrees C, s.u.	(s.u.)	7.5
Nitrate + Nitrite as N	(mg/l)	5.70
Cadmium, Dissolved	(mg/l)	0.006
Copper, Dissolved	(mg/l)	<0.01
Iron, Dissolved	(mg/l)	<0.03
Lead, Dissolved	(mg/l)	<0.01
Zinc, Dissolved	(mg/l)	0.02

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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

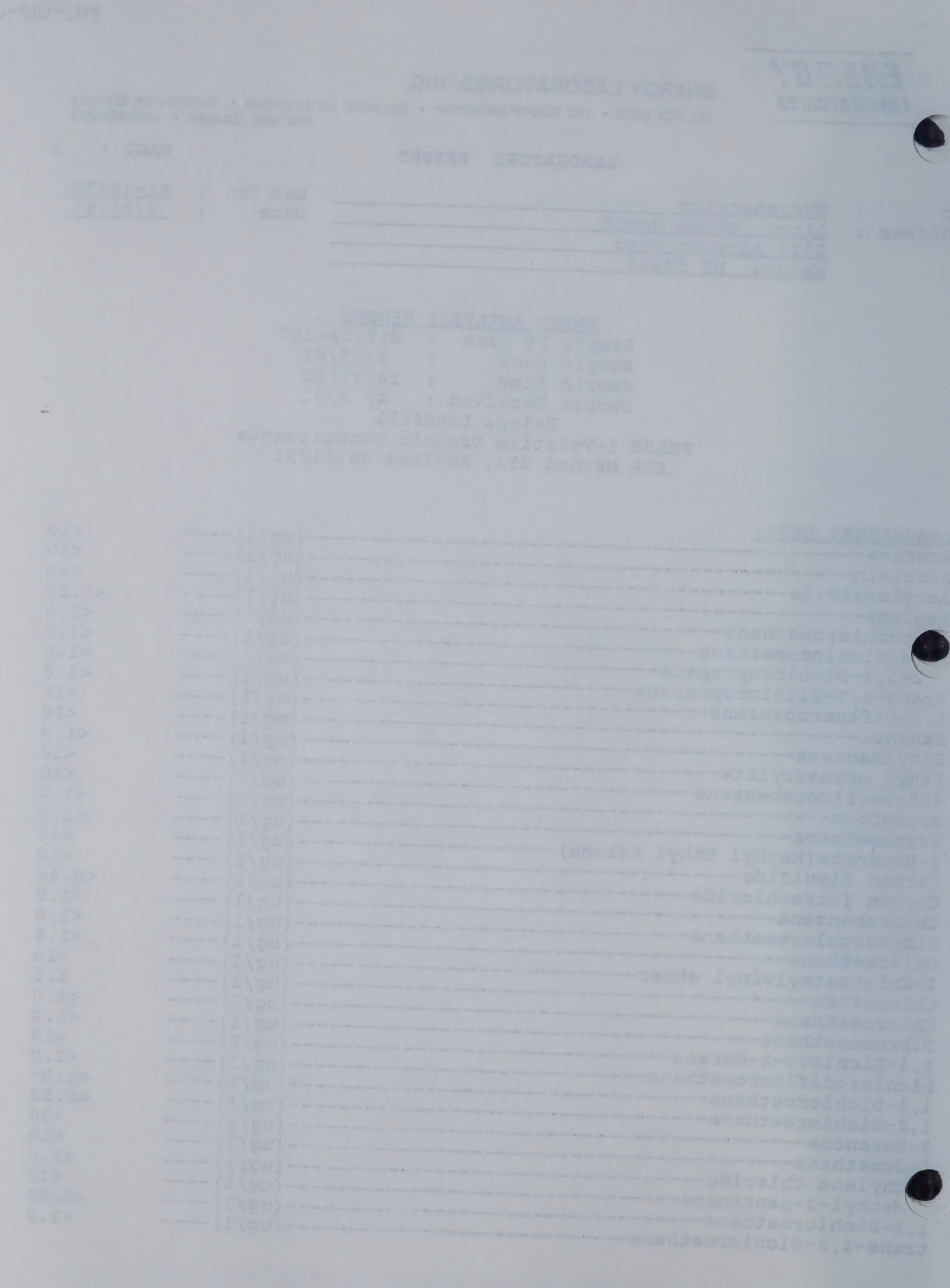
Lab No. : 91-12770
Date : 6/21/91

WATER ANALYSIS REPORT

Sample Pt Name : HL9104-107
Sample Date : 4/ 5/91
Sample Time : 14:30:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:		
Acetone	(ug/l)	<10
Acrolein	(ug/l)	<10
Acrylonitrile	(ug/l)	<10
Benzene	(ug/l)	<0.50
Bromochloromethane	(ug/l)	<1.0
Bromodichloromethane	(ug/l)	<1.0
cis-1,3-Dichloropropene	(ug/l)	<1.0
trans-1,3-Dichloropropene	(ug/l)	<1.0
1,4-Difluorobenzene	(ug/l)	<10
Ethanol	(mg/l)	<10
Ethylbenzene	(ug/l)	<1.0
Ethyl methacrylate	(ug/l)	<10
4-Bromofluorobenzene	(ug/l)	<10
Bromoform	(ug/l)	<1.0
Bromomethane	(ug/l)	<1.0
2-Butanone(Methyl Ethyl Ketone)	(ug/l)	<10
Carbon disulfide	(ug/l)	<10
Carbon Tetrachloride	(ug/l)	<0.50
Chlorobenzene	(ug/l)	<1.0
Dibromochloromethane	(ug/l)	<1.0
Chloroethane	(ug/l)	<1.0
2-Chloroethylvinyl ether	(ug/l)	<10
Chloroform	(ug/l)	5.8
Chloromethane	(ug/l)	<1.0
Dibromomethane	(ug/l)	<1.0
1,4-Dichloro-2-butene	(ug/l)	<10
Dichlorodifluoromethane	(ug/l)	<1.0
1,1-Dichloroethane	(ug/l)	<1.0*
1,2-Dichloroethane	(ug/l)	<0.50
2-Hexanone	(ug/l)	<10
Iodomethane	(ug/l)	<10
Methylene Chloride	(ug/l)	<1.0
4-Methyl-2-pentanone	(ug/l)	<10
1,1-Dichloroethene	(ug/l)	<0.50
trans-1,2-Dichloroethene	(ug/l)	<1.0

CC:



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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59601

Lab No. : 91-12770
Date : 6/21/91

WATER ANALYSIS REPORT
Sample Pt Name : HL9104-107
Sample Date : 4/ 5/91
Sample Time : 14:30:00
Sample Received : 4/ 9/91
Helena Landfill
PHASE 1-Volatile Organic Constituents
EPA Method 624, Revised 06/21/91

LABORATORY DATA:

Styrene	(ug/l)	<1.0
1,1,2,2-Tetrachloroethane	(ug/l)	<1.0
Toluene	(ug/l)	<0.50
1,1,1-Trichloroethane	(ug/l)	<1.0
1,1,2-Trichloroethane	(ug/l)	0.65
richloroethene	(ug/l)	<1.0
richlorofluoromethane	(ug/l)	<1.0
1,2,3-Trichloropropane	(ug/l)	<10
Vinyl acetate	(ug/l)	<0.50
Vinyl chloride	(ug/l)	<1.0
Xylenes	(ug/l)	1.9
Tetrachloroethene	(ug/l)	

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LABORATORY REPORT

To : Hydrometrics
Address : Attn: Steve Downs
2727 Airport Road
Helena, MT 59061

Lab No. : 91-12770
Date : 4/24/91

WATER ANALYSIS REPORT
Sample Pt Name : HL9104-107
Sample Date : 4/ 5/91
Sample Time : 14:30:00
Sample Received : 4/ 9/91
Helena Landfill

LABORATORY DATA:

Potassium, Dissolved	(mg/l)	4
Sodium, Dissolved	(mg/l)	83
Calcium, Dissolved	(mg/l)	108
Magnesium, Dissolved	(mg/l)	39
Sulfate as SO4	(mg/l)	134
Chloride	(mg/l)	29
Carbonate as CO3	(mg/l)	0
Bicarbonate as HCO3	(mg/l)	479
Solids, Dissolved @ 180 degrees C	(mg/l)	662
Alkalinity, Total as CaCO3, pH 4.5	(mg/l)	393
pH @ 25 degrees C, s.u.	(s.u.)	7.7
Nitrate + Nitrite as N	(mg/l)	6.91
Nitrogen, Ammonia	(mg/l)	<0.1
Chemical Oxygen Demand	(mg/l)	3
Organic Carbon, Total	(mg/l)	2
Cyanide, Total	(mg/l)	<0.005
Arsenic, Dissolved	(mg/l)	<0.005
Barium, Dissolved	(mg/l)	<0.1
Cadmium, Dissolved	(mg/l)	0.002
Chromium, Dissolved	(mg/l)	<0.02
Iron, Dissolved	(mg/l)	<0.03
Lead, Dissolved	(mg/l)	<0.01
Manganese, Dissolved	(mg/l)	<0.02
Mercury, Dissolved	(mg/l)	<0.001
Selenium, Dissolved	(mg/l)	<0.005
Silver, Dissolved	(mg/l)	<0.005

cc:

CITY WATER (625 WILDER)

ENERGY LABORATORIES, INC.
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LABORATORY REPORT

LAB NO.: 90-15043
DATE: 06/18/90 dya

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601



WATER ANALYSIS
Helena City Landfill
HL-9006-105
Sampled 06/06/90 @ 1230
Submitted 06/07/90
625 Wilder (City Water)

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	70
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	3.2
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15041
DATE: 06/18/90 dya

WATER ANALYSIS
Helena City Landfill
HL-9006-103
Sampled 06/05/90 @ 1120
Submitted 06/07/90
CARWASH (CITY WATER)

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	88
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	5.5
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	1.1
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed i
accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

CITY WATER (FAIRGROUNDS)

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15039
DATE: 06/18/90 dya

WATER ANALYSIS

Helena City Landfill
HL-9006-101
Sampled 06/05/90 @ 1045
Submitted 06/07/90
Fairgound (City Water)

Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	88
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	5.3
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed in accordance with EPA Method 502.2.

*Present but less than the practical quantitation limit.

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59620

LAB NO.: 89-20180 -85
DATE: 11/27/89 dya

RECEIVED

EPA WATER SUPPLY QUALITY CONTROL SAMPLE

Volatile Organic Contaminants

This EPA reference sample was analyzed with your sample no.s 89-20180 -85 with the following results:

Parameter	True Value. µg/l	P (%)	Range for P (%)
Benzene	4.9	103	60 - 140
Ethylbenzene	5.0	114	60 - 140
m-Xylene	4.9	120	60 - 140
n-propylbenzene	5.0	104	60 - 140
2-Chlorotoluene	5.0	98	60 - 140
1,3,5-Trimethylbenzene	5.0	110	60 - 140
1,4-Dichlorobenzene	5.2	103	60 - 140

P = Percent recovery measured.

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59601

LAB NO.: 89-20181 spi
DATE: 11/27/89 dya

NOV RECEIVED

QUALITY ASSURANCE - SPIKED ANALYSIS

Lab No. 89-20181 was spiked with the following constituents with these results:

Constituent	Spike Amount, ug/l	Ps (%)	Range for Ps (%)
Toluene	5.0	100	60 - 140
Chlorobenzene	5.0	108	60 - 140
Isopropylbenzene	5.0	88	60 - 140
sec-Butylbenzene	5.0	104	60 - 140
1,2,4-Trimethylbenzene	5.0	92	60 - 140
n-Butylbenzene	5.0	100	60 - 140
1,2-Dichlorobenzene	5.0	96	60 - 140

Ps = Percent recovery measured.

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LABORATORY REPORT

LAB NO.: 90-7837
DATE: 04/27/90 dya

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

Water Volatile Surrogate Recovery

Sample No.	S1 (TOL)#	S2 (BFB)#	S3 (DCE)#
90-7837	115	104	110

	QC Limits
S1 (TOL) = Toluene-d8	80 - 120
S2 (BFB) = Bromofluorobenzene	80 - 120
S3 (DCE) = 1,2-Dichloroethane-d4	80 - 120

Column to be used to flag recovery values with an asterisk.

* Values outside of contract required QC limits.

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LABORATORY REPORT

LAB NO.: 90-10831
DATE: 05/23/90 dya

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

QUALITY ASSURANCE - SPIKED ANALYSIS

Lab No. 90-10831 was spiked with the following constituents with these results:

Constituent	Spike Amount, ug/l	P (%)	Range for P (%)
1,1-Dichloroethene	5.0	113	60 - 140
Benzene	5.0	119	60 - 140
Trichloroethene	5.0	134	60 - 140
Toluene	5.0	108	60 - 140
Chlorobenzene	5.0	124	60 - 140

P = Percent recovery measured.

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LABORATORY REPORT

LAB NO.: 90-10821
DATE: 05/23/90 dya

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

QUALITY ASSURANCE - SPIKED ANALYSIS

Lab No. 90-10821 was spiked with the following constituents with these results:

Constituent	Spike Amount, ug/l	P (%)	Range for P (%)
1,1-Dichloroethene	5.0	102	60 - 140
Benzene	5.0	126	60 - 140
Trichloroethene	5.0	117	60 - 140
Toluene	5.0	122	60 - 140
Chlorobenzene	5.0	126	60 - 140

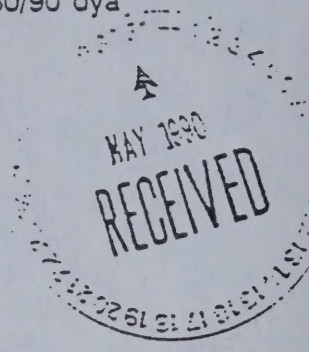
P = Percent recovery measured.

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LABORATORY REPORT

LAB NO.: 90-12197 -99
DATE: 05/30/90 dya

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601



WATER SEMIVOLATILE SURROGATE RECOVERY

Sample No.	S1 (NBZ)#	S2 (FBP)#	S3 (TPH)#	S4 (PHL)#	S5 (2FP)#	S6 (TBP)#
90-12197	43	56	140	31	30	46
90-12198	67	70	85	22	22	38
90-12199	69	75	94	21	21	38

	QC LIMITS
S1 (NBZ) = Nitrobenzene-d5	35-114
S2 (FBP) = 2-Fluorobiphenyl	43-116
S3 (TPH) = Terphenyl-d14	33-141
S4 (PHL) = Phenol-d5	10-94
S5 (2FP) = 2-Fluorophenol	21-100
S6 (TBP) = 2,4,6-Tribromophenol	10-123

Column to be used to flag recovery values with an asterisk.

* Values outside of contract required QC limits

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Randy Huffsmith
2727 Airport Road
Helena, MT 59601

LAB NO.: 90-15041
DATE: 05/18/90 dya

QUALITY ASSURANCE - SPIKED ANALYSIS

Lab No. 90-15041 was spiked with the following constituents with these results:

Constituent	Spike Amount, ug/l	P (%)	Range for P (%)
1,1-Dichloroethene	5.0	64	60 - 140
Benzene	5.0	96	60 - 140
Trichloroethene	5.0	93	60 - 140
Toluene	5.0	100	60 - 140
Chlorobenzene	5.0	104	60 - 140

P = Percent recovery measured.

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 91-13086 -88
DATE: 04/29/91 da

WATER VOLATILE SURROGATE RECOVERY

10 µg/l Surrogate Standard Spike

	------% recovery------		
SAMPLE NO.	S1 (TOL)#	S2 (BFB)#	S3 (DCE)#
91-13086	96	104	92
91-13087	97	102	91
91-13088	88	101	100

	QC LIMITS, % Recovery
S1 (TOL) = Toluene-d8	80-120
S2 (BFB) = Bromofluorobenzene	80-120
S3 (DCE) = 1,2-Dichloroethane-d4	80-120

#Column to be used to flag recovery values with an asterisk.

*Values outside of contract required QC limits.

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.

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LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Billy Pratt
2727 Airport Road
Helena, MT 59601

LAB NO.: 89-20184
DATE: 11/27/89 dya

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WATER ANALYSIS
Helena Landfill
HL-8911-005
Sampled 11/11/89 @ 1900
Submitted 11/14/89

Volatile Organic Constituent	µg/l	Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0	1,1,1,2-Tetrachloroethane	<1.0
Chloromethane	<1.0	Ethylbenzene	<1.0
Vinyl chloride	<0.50	p-Xylene	<1.0
Bromomethane	<1.0	m-Xylene	<1.0
Chloroethane	<1.0	o-Xylene	<1.0
Trichlorofluoromethane	<1.0	Styrene	<1.0
1,1-Dichloroethene	<0.50	Bromoform	<1.0
Methylene Chloride	<1.0	Isopropylbenzene	<1.0
trans-1,2-Dichloroethene	<1.0	1,1,2,2-Tetrachloroethane	<1.0
1,1-Dichloroethane	<1.0	Bromobenzene	<1.0
2,2-Dichloropropane	<1.0	1,2,3-Trichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0	n-Propylbenzene	<1.0
Chloroform	<1.0	2-Chlorotoluene	<1.0
Bromochloromethane	<1.0	1,3,5-Trimethylbenzene	<1.0
1,1,1-Trichloroethane	<0.50	4-Chlorotoluene	<1.0
Carbon Tetrachloride	<0.50	tert-Butylbenzene	<1.0
1,1-Dichloropropene	<1.0	1,2,4-Trimethylbenzene	<1.0
Benzene	0.73	sec-Butylbenzene	<1.0
1,2-Dichloroethane	<0.50	p-Isopropyltoluene	<1.0
Trichloroethene	<0.50	1,3-Dichlorobenzene	<1.0
1,2-Dichloropropane	<1.0	1,4-Dichlorobenzene	<0.50
Bromodichloromethane	<1.0	n-Butylbenzene	<1.0
Dibromomethane	<1.0	1,2-Dichlorobenzene	<1.0
Toluene	1.0	1,2-Dibromo-3-Chloropropane	<1.0
1,1,2-Trichloroethane	<1.0	1,2,4-Trichlorobenzene	<1.0
Tetrachloroethene	<0.50	Hexachlorobutadiene	<1.0
1,3-Dichloropropane	<1.0	Naphthalene	<1.0
Dibromochloromethane	<1.0	1,2,3-Trichlorobenzene	<1.0
1,2-Dibromoethane	<1.0	cis-1,3-Dichloropropene	<1.0
Chlorobenzene	<1.0	trans-1,3-Dichloropropene	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed accordance with EPA method 502.2

*Present but less than the practical quantitation limit.

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LABORATORY REPORT

LAB NO.: 90-10832
DATE: 05/23/90 dya

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

WATER ANALYSIS

Helena Landfill
HL-9005-115
Sampled 05/07/90 @ 0915
Submitted 05/08/90

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Volatile Organic Constituent	µg/l
Dichlorodifluoromethane	<1.0
Chloromethane	<1.0
Vinyl chloride	<0.50
Bromomethane	<1.0
Chloroethane	<1.0
Trichlorofluoromethane	<1.0
1,1-Dichloroethene	<0.50
Methylene Chloride	<1.0
trans-1,2-Dichloroethene	<1.0
1,1-Dichloroethane	<1.0
2,2-Dichloropropane	<1.0
cis-1,2-Dichloroethene	<1.0
Chloroform	<1.0
Bromochloromethane	<1.0
1,1,1-Trichloroethane	<0.50
Carbon Tetrachloride	<0.50
1,1-Dichloropropene	<1.0
Benzene	<0.50
1,2-Dichloroethane	<0.50
Trichloroethene	<0.50
1,2-Dichloropropane	<1.0
Bromodichloromethane	<1.0
Dibromomethane	<1.0
Toluene	<1.0
1,1,2-Trichloroethane	<1.0
Tetrachloroethene	<0.50
1,3-Dichloropropane	<1.0
Dibromochloromethane	<1.0
1,2-Dibromoethane	<1.0
Chlorobenzene	<1.0

Volatile Organic Constituent	µg/l
1,1,1,2-Tetrachloroethane	<1.0
Ethylbenzene	<1.0
p-Xylene	<1.0
m-Xylene	<1.0
o-Xylene	<1.0
Styrene	<1.0
Bromoform	<1.0
Isopropylbenzene	<1.0
1,1,2,2-Tetrachloroethane	<1.0
Bromobenzene	<1.0
1,2,3-Trichloropropane	<1.0
n-Propylbenzene	<1.0
2-Chlorotoluene	<1.0
1,3,5-Trimethylbenzene	<1.0
4-Chlorotoluene	<1.0
tert-Butylbenzene	<1.0
1,2,4-Trimethylbenzene	<1.0
sec-Butylbenzene	<1.0
p-Isopropyltoluene	<1.0
1,3-Dichlorobenzene	<1.0
1,4-Dichlorobenzene	<0.50
n-Butylbenzene	<1.0
1,2-Dichlorobenzene	<1.0
1,2-Dibromo-3-Chloropropane	<1.0
1,2,4-Trichlorobenzene	<1.0
Hexachlorobutadiene	<1.0
Naphthalene	<1.0
1,2,3-Trichlorobenzene	<1.0
cis-1,3-Dichloropropene	<1.0
trans-1,3-Dichloropropene	<1.0
Dichloromonofluoromethane	<1.0

REMARKS: Sample was properly preserved and in specified container. Sample was analyzed accordance with EPA Method 502.2

*Present but less than the practical quantitation limit.

APPENDIX D.

SOIL TESTING RESULTS

HELENA LANDILL
DOUBLE RING INFILTROMETER TESTS

SITE NAME: HLDR-1

DRY RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
5	90	5.93E-04
35	50	5.49E-05
65	40	4.39E-05
95	40	4.39E-05
100	5	3.29E-05

WET RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
20	15	2.47E-05
50	35	3.84E-05
80	35	3.84E-05
110	40	4.39E-05

HELENA LANDILL
DOUBLE RING INFILTROMETER TESTS

SITE NAME: HLDR-2

DRY RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
5	90	5.93E-04
20	60	1.32E-04
60	110	9.06E-05

WET RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
30	80	8.78E-05
60	80	8.78E-05

HELENA LANDILL
DOUBLE RING INFILTROMETER TESTS

SITE NAME: HLDR-3

DRY RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
5	450	2.96E-03
13	180	7.41E-04
28	260	5.71E-04
58	380	4.17E-04

WET RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
30	420	4.61E-04
60	390	4.28E-04
90	390	4.28E-04

HELENA LANDILL
DOUBLE RING INFILTROMETER TESTS

SITE NAME: HLDR-4

DRY RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
5	525	3.46E-03
15	100	3.29E-04
30	130	2.85E-04
60	215	2.36E-04

WET RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
30	180	1.98E-04
60	155	1.70E-04
90	220	2.42E-04

HELENA LANDILL
DOUBLE RING INFILTROMETER TESTS

SITE NAME: RPDR-1

DRY RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
15	170	3.73E-04
45	90	9.88E-05
115	70	3.29E-05

WET RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
30	60	6.59E-05
90	150	8.23E-05
170	230	9.47E-05

HELENA LANDILL
DOUBLE RING INFILTROMETER TESTS

SITE NAME: RPDR-2

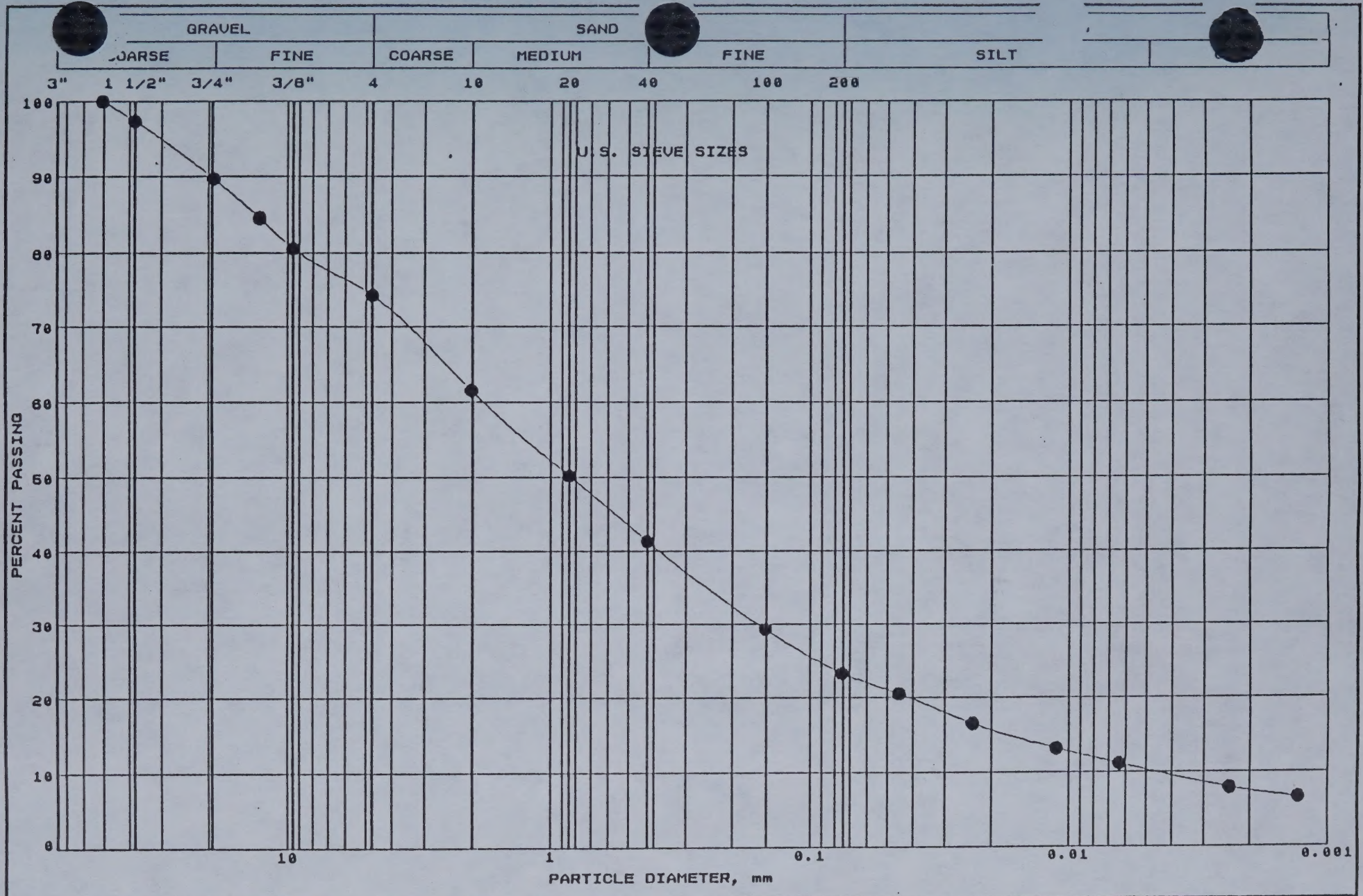
DRY RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
15	350	7.69E-04
30	10	2.20E-05
60	410	4.50E-04

WET RUN

TIME SINCE TEST START (MINUTES)	VOLUME ADDED TO INNER RING (ML)	INFILTRATION RATE (CM/SEC)
30	270	2.96E-04
90	600	3.29E-04
172	730	2.93E-04

GRAIN SIZE ANALYSIS CURVE



BRAUN

INTERTEC

PROJECT NO.: 8HDX-91-089L

Helena Landfill Project

Helena, MT.

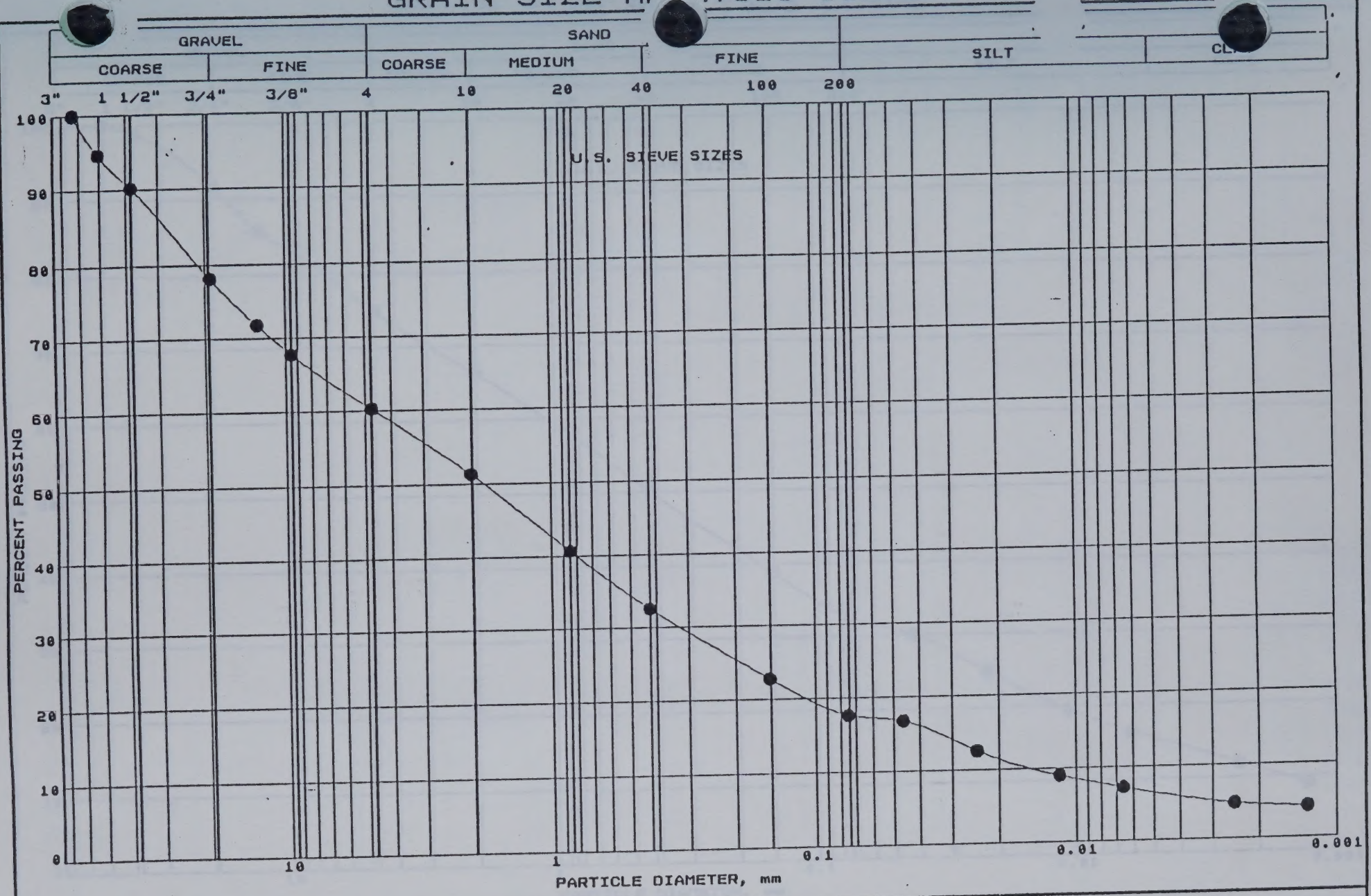
SAMPLE NO.: HL9105-8 (1540/1550)

USDA Classification

% GRAVEL:	39.0
% SAND:	40.0
% SILT:	13.5
% CLAY:	7.5

Class: Gravelly Sandy Loam

GRAIN SIZE ANALYSIS CURVE



BRAUN

INTERTEC

PROJECT NO.: BHDX-91-089L

Helena Landfill Project

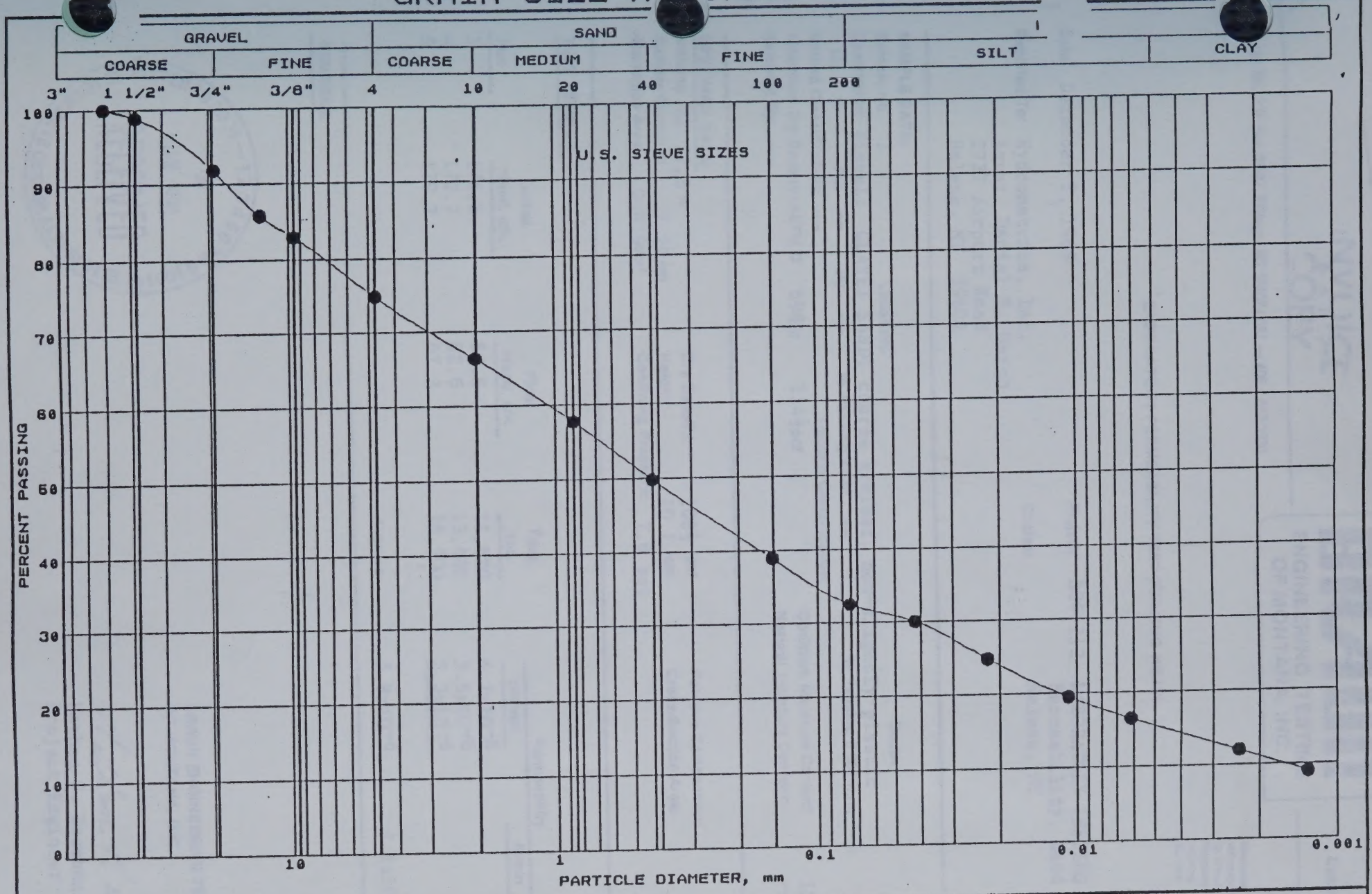
Helena, MT.

SAMPLE NO.: HL9105-A (1600)

USDA Classification

% GRAVEL:	48.0
% SAND:	36.0
% SILT:	12.6
% CLAY:	4.5
Class:	Gravelly Sandy Loam

GRAIN SIZE ANALYSIS CURVE



BRAUN

INTERTEC

PROJECT NO.: BHDX-91-069L

Helena Landfill Project

Helena, MT.

SAMPLE NO.: HL9105-C (1600)

USDA Classification

% GRAVEL: 34.0
% SAND: 36.0
% SILT: 20.0
% CLAY: 11.0
Class: Gravelly Sandy Loam



INVOICE COPY

BRAUN
ENGINEERING TESTING
OF MONTANA, INC.

Quality Services Since 1957

...age Rd., P.O. Box 30697, Billings, MT 59107-0697 — 406 / 652-3930

Affiliated Offices:
Minnesota: Minneapolis, St. Cloud, Rochester, Hibbing, St. Paul
North Dakota: Williston, Bismarck
Montana: Billings, Bozeman
Illinois: Chicago

LABORATORY PERMEABILITY TEST (FALLING HEAD)

Date: December 1, 1989

Project: B89-212 LABORATORY TESTING
Permeability, Land Fill
Helena, MT

Copies:

Reported To: Hydrometrics, Inc.
Attn: Daniel E. March
2727 Airport Road
Helena, MT 59601

SAMPLE DATA:

Sample No. 1 Location: Depth:

Description: Visual: CLAYEY SAND, coarse grained, non-slightly plastic

LL: -- PL: -- PI: -- % Passing #200: -- % Passing 0.002 mm: --

Unified Classification: -- Textural Classification:

Maximum Dry Density (ASTM D 698): 114½pcf Optimum Moisture Content: 15 %

Sampled By: -- Natural Moisture Content: -- %

SPECIMAN DATA:

Molding MC: 17.8% Dry Density: 108½ pcf Relative Compaction: 95 %

Sample Diameter: 7.29 cm Height: 10.1 cm Cross-Section Area: 41.74 cm²

Standpipe Area: 0.419 cm² Confining Pressure: 7.8 psi

TEST RESULTS:

Run	Initial Head, cm.	Final Head, cm.	Time, sec.	Permeability cm/sec	Permeability ft/min
3	176.6	80.6	11,820	6.7×10^{-6}	
4	172.7	82.6	13,680	5.5×10^{-6}	
5	179.7	67.3	18,900	5.3×10^{-6}	
			Average	5.8×10^{-6}	1.1×10^{-5}

REMARKS:

JAN 1990
RECEIVED

BRAUN ENGINEERING TESTING
OF MONTANA, INC.

Nathan P. Boeshans

Nathan P. Boeshans
Project Engineer

APPENDIX E.

METHANE INFORMATION

Dear Sir:

The following letter is to inform you of a condition at and peripheral to the City of Helena Landfill. During the natural breakdown of landfilled refuse, methane gas is formed. This methane can create explosive conditions and a low oxygen environment in sub-grade structures and excavations. Even though the levels of methane do not appear to be of concern in the landfill area, the City of Helena believes you should be aware of the potential problem and exercise precautionary measures when servicing any underground utilities or excavating in the vicinity of the landfill.

In the recent past, the City has monitored and sampled in numerous areas in and near the landfill. The results indicate that methane concentrations in monitoring wells and structures are well below the lower explosive limit and that these low concentrations of methane diminish a short distance from the landfilled area. However, we recommend monitoring oxygen and methane levels in any excavations, or when working in any sub-grade structures in or directly adjacent to the City landfill.

The City of Helena Fire Department is continuing to closely monitor this situation and should you have any questions we would be glad to be of assistance.

Sincerely,

Richard Nisbet, P.E.
Director of Public Works

RN:kab

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 91-26557
DATE: 08/02/91 da

NATURAL GAS ANALYSIS REPORT

Helena Landfill
HL9107-1A
Sampled 07/23/91 @ 0930
Submitted 07/25/91

CHROMATOGRAPH ANALYSIS

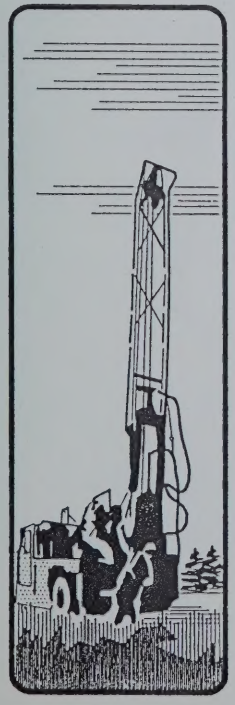
Constituent	Volume, %
Oxygen	20.86
Nitrogen	77.72
Carbon dioxide	1.12
Hydrogen Sulfide	
Methane	0.30
Ethane	0.00
Propane	0.00
Isobutane	0.00
N-Butane	0.00
Isopentane	0.00
N-Pentane	0.00
Hexanes plus	0.00
Totals	100.00



Helena Landfill Closure Plan

Submitted To:
Montana Department of Health and Environmental Sciences

Submitted By:
City of Helena
Helena, Montana



Prepared By:
Hydrometrics, Inc.
Consulting Scientists and Engineers
Helena, Montana 59601

HELENA LANDFILL CLOSURE PLAN

Submitted to:

Montana Department of Health and
Environmental Sciences
Solid and Hazardous Waste Bureau
Cogswell Building
Helena, MT 59620

By:

City of Helena
316 North Park
Helena, MT 59620

Prepared by:

Hydrometrics, Inc.
2727 Airport Road
Helena, MT 59601

September 1991

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APPENDIX D. SOIL TESTING RESULTS

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HELENA LANDFILL CLOSURE PLAN

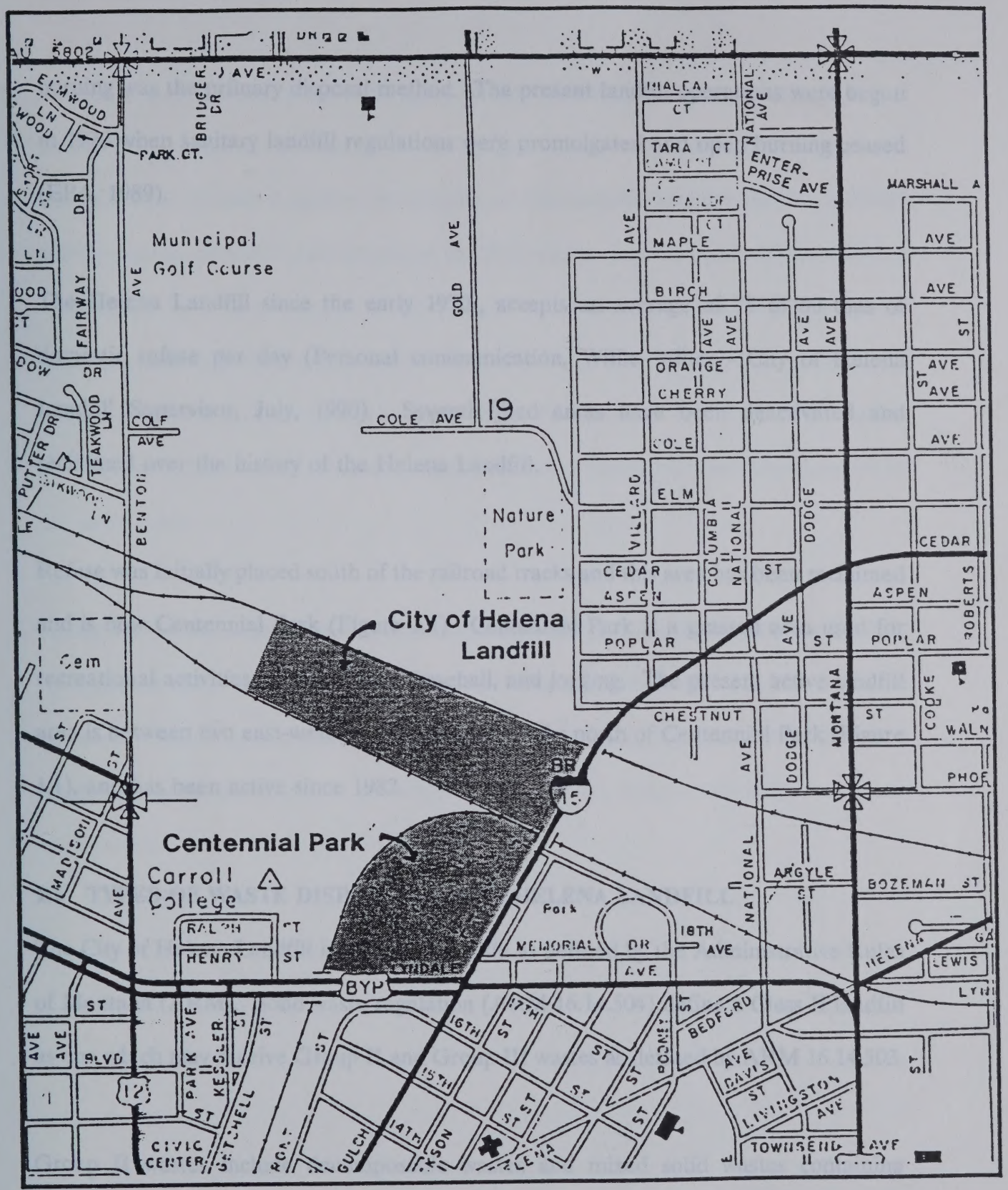
1.0 INTRODUCTION

This closure plan for the City of Helena Landfill is designed to meet all requirements set forth by the State of Montana in the Administrative Rules of Montana, Title 16, Chapter 14 - Solid Waste Management, Sub-chapter 5 - Refuse Disposal; and Sub-chapter 7 - Proposed Groundwater Monitoring Rules for Landfills in Montana. These regulations are also outlined in the Montana Department of Health and Environmental Sciences (MDHES), Solid and Hazardous Waste Bureau's document of April 3, 1991, entitled "Class II Landfill Closure Requirements and Recommendations".

The final closure date of the City of Helena Landfill is dependant on opening of the new Lewis and Clark County "Site E" Landfill which is in the permitting process at this time. Due to the uncertainty of the opening date of the new landfill, the final closure date for the City of Helena Landfill cannot be given. The City of Helena plans to operate under an interim closure for this period and will coordinate all final closure activities with the MDHES at the appropriate time.

1.1 OPERATING HISTORY OF HELENA LANDFILL

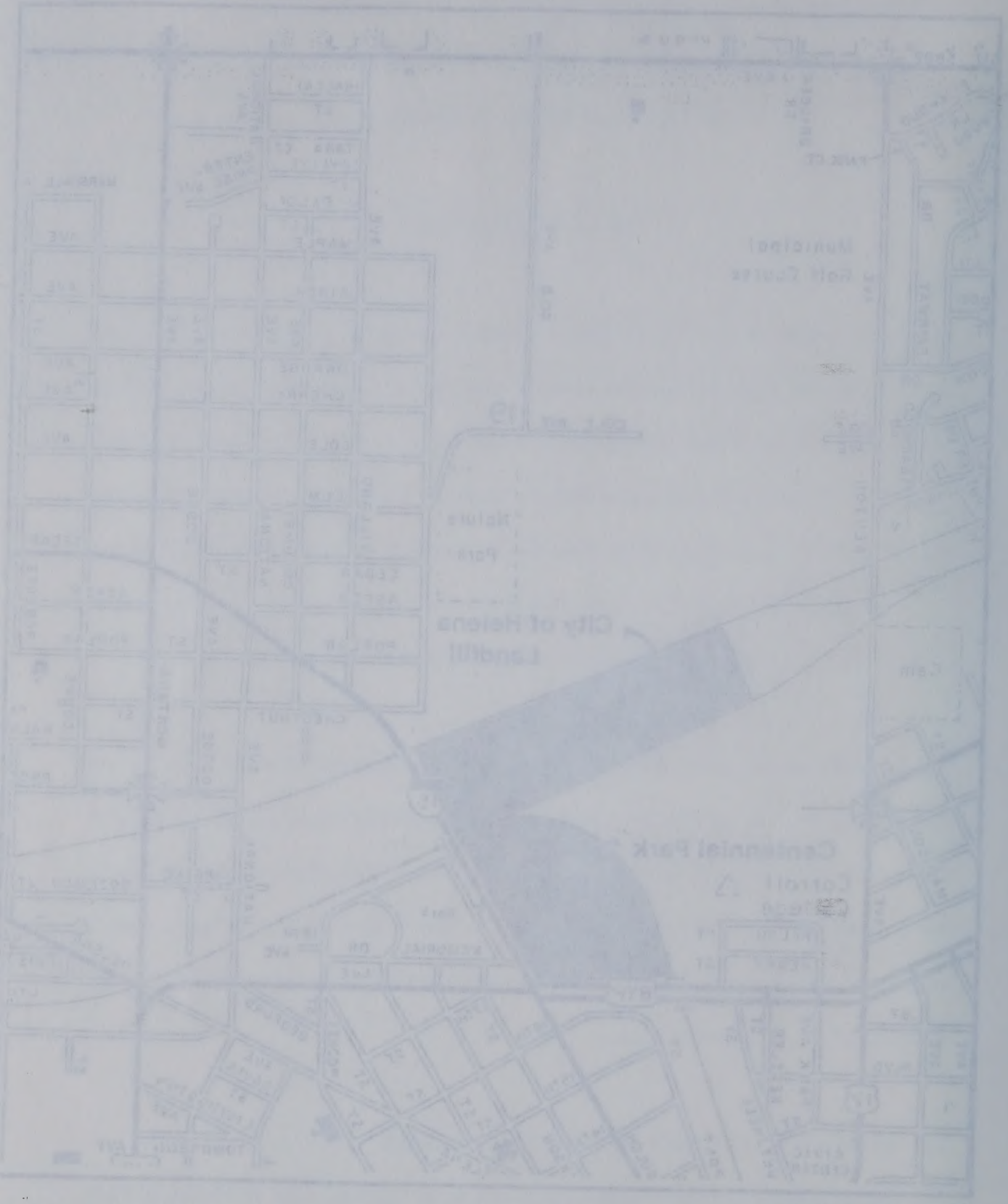
The City of Helena Landfill is located east of Carroll College, west of Memorial Park, and North of Lyndale Avenue (Figure 1.1). The landfill encompasses about 37 acres of active and inactive landfill areas. The landfill was activated in the late 1800s when open



Scale: 1" = 1000 feet

NORTH

Figure 1.1: City of Helena Landfill Location Map



burning was the primary disposal method. The present landfill operations were begun in 1970 when sanitary landfill regulations were promulgated and open burning ceased (EPA, 1989).

The Helena Landfill since the early 1970s, accepts an average of 75 to 80 tons of domestic refuse per day (Personal communication, Willie Miller - City of Helena Landfill Supervisor, July, 1990). Several filled areas have been deactivated and reclaimed over the history of the Helena Landfill.

Refuse was initially placed south of the railroad tracks and this area has been reclaimed and is now Centennial Park (Figure 1.1). Centennial Park is a grassed area used for recreational activities such as soccer, baseball, and jogging. The present active landfill area is between two east-west running railroad tracks north of Centennial Park (Figure 1.1), and has been active since 1982.

1.2 TYPES OF WASTE DISPOSED AT THE HELENA LANDFILL

The City of Helena Landfill is a Class II landfill as defined by the Administrative Rules of Montana (ARM). Solid waste regulation (ARM 16.14.504) define a Class II landfill as one which may receive Group II and Group III wastes as defined by ARM 16.14.503.

Group II wastes include decomposable wastes and mixed solid wastes containing decomposable material but exclude hazardous wastes. Examples include, but are not limited to municipal and domestic wastes such as garbage and putrescible organic

materials, paper, cardboard, cloth, glass, metal, plastics, street sweepings, yard and garden wastes, digested sewage treatment sludges, water treatment sludges, ashes, dead animals, offal, discarded appliances, abandoned automobiles, and hospital and medical facility wastes, provided that infectious medical wastes have been sterilized or safely contained to prevent the danger of disease; and commercial and industrial wastes such as packaging materials, liquid or solid industrial process wastes which are chemically or biologically decomposable, crop residues, manure, chemical fertilizers and emptied pesticide containers which have been triple rinsed or processed by methods approved by the department.

Group III wastes include wood wastes and non-water soluble, essentially inert solids. Examples include, but are not limited to inert solid waste such as brick, dirt, rock and concrete; wood materials, brush, lumber, and vehicle tires; and industrial mineral wastes which are essentially inert and non-water soluble, and do not contain hazardous waste constituents.

2.0 HYDROGEOLOGY OF THE HELENA LANDFILL AREA

Several studies evaluating soils, hydrogeology and water quality in the Helena Landfill area have been conducted in recent years. These studies include EPA Field Investigation Team studies in 1987 and 1989, Hydrometrics, Inc.'s studies in 1982, 1983 and 1990, and F and M Consultants' study in 1982. The United States Geological Survey has also conducted several studies of the geology and hydrogeology of the Helena Valley. All of these studies have been considered in the preparation of this closure plan.

2.1 GEOLOGIC SETTING

The City of Helena Landfill is located at the edge of the Helena Valley near the base of Mount Helena. The hills and mountains peripheral to the Helena Valley are folded and faulted igneous, sedimentary and metamorphic rocks that range in geological age from Precambrian to Tertiary (Wilke and Coffin, 1973).

The Helena Landfill is at the mouth of Last Chance Gulch at the southern edge of the Helena Valley. The gulch in this area is underlain with alluvial deposits of Quaternary and Tertiary geological age that are in geological contact with igneous bedrock at Carroll College and limestone bedrock beneath the U.S. National Guard Armory and YMCA buildings adjacent to Last Chance Gulch. The alluvial stream and fan deposits are indistinguishable and are composed of layers, lenses and mixtures of unconsolidated clay, silt, sand, gravel and cobbles (Coffin, 1971). The alluvial material is variable in lithology with limestone and dolomite clasts from the Precambrian Helena Dolomite Formation,

and clasts of intrusive igneous rocks of Cretaceous age being common. The former has been uplifted and exposed to the south of Helena, and the latter is present as an elevated bedrock hill in the Carroll College area. Alluvial fan and stream deposits were probably deposited by an interconnecting network of paleochannels which resulted in the heterogeneous alluvium at the mouth of Last Chance Gulch.

In the vicinity of the Bill Roberts Golf Course (just north of the landfill), the Quaternary alluvium has been extensively placer mined for gold. The dredge tailings vary in thickness from 25 to 50 feet and are underlain by unconsolidated to semi-consolidated sediments of Tertiary age and by alluvium to deep to dredge. The Tertiary sediments vary in thickness from many hundreds of feet in the central Helena Valley to relatively thin deposits along the valley's edges (Hydrometrics, 1982). These Tertiary sediments are underlain by the Precambrian Helena Dolomite Formation and possibly the Empire and Spokane Formations. The Helena Dolomite is a siliceous dolomite with subordinate limestone. Wells located just north of Carroll College are completed in this formation and yield only small quantities of water. An irrigation well drilled in the Bill Roberts Golf Course encountered a green argillite at a depth of about 200 feet. This argillite is likely a Precambrian age rock of the Empire and Spokane Formation, or the Marsh Formation. The bedrock mound that forms the hill on which Carroll College sits an igneous intrusive (diorite porphyry) which intruded upward through the older formations.

2.2 HYDROGEOLOGY OF THE HELENA LANDFILL AREA

Groundwater in the landfill area occurs both in the alluvium and the underlying bedrock. North of the landfill, groundwater occurs in dredge piles left by historic mining at the mouth of Last Chance Gulch, and in the semi-consolidated Tertiary sediments. These sediments are heterogenous in nature.

Groundwater flow in the study area is generally to the north and northwest with an average gradient of about 0.05 ft/ft. Exhibit 1 shows a potentiometric surface map of the alluvial system. Hydrometrics (1982) estimated the groundwater flow rate through the alluvium underlying the landfill to be approximately 28 gallons per minute. This flow rate is based on a hydraulic conductivity of 100 gpd/ft^2 (F and M Consultants, 1982), an average saturated thickness of 20 feet, and an average valley width of 400 feet. Assuming a porosity of 25% for the alluvium, the average groundwater velocity in the vicinity of the landfill is estimated to be 2.68 ft/day. Based on additional data obtained by Hydrometrics, Inc. in 1990, these earlier velocity and flow estimates could be as much as an order of magnitude low. Table 2.1 shows hydrogeological characteristics of selected sites in the landfill area. At these sites, transmissivity (the ability to transmit water) of the alluvium ranges at these sites from 1,680 gpd/ft to 33,000 gpd/ft (Hydrometrics, 1990). This broad range is due to the heterogeneous nature of the alluvium in the landfill area.

The unconsolidated alluvium varies in texture from a silty or clayey sand to medium or coarse-grained sand containing gravel and cobbles. Textural variations are likely due

Table 2.1: Hydrogeologic Characteristics Of Selected Sites

WELL OR PIT	GEOLOGIC MATERIAL	TRANSMISSIVITY	HYDRAULIC CONDUCTIVITY
GOLF COURSE TW-1	Poorly sorted alluvium - sand, gravel, cobbles and minor clay	7920 gpd/ft	2x10-3 cm/sec
GOLF COURSE TW-3	Semi-consolidated bedrock "Caliche"	1680 gpd/ft	7x10-4 cm/sec
South Pit *	Disturbed stream channel	11,000 gpd/ft	
North Pit *	Coarse sandy gravel	33,000 gpd/ft	

* From Robert Peccia and Associates (1982) Study For Bill Roberts Municipal Golf Course

MAP LOCATION	APPROX. SPECIFIC CAPACITY	MAP LOCATION	APPROX. SPECIFIC CAPACITY
1	0.36	36	1
5	1.25	37	0.3
6	0.41	38	0.36
7	0.81	39	1
13	0.31	40	1
15	0.24	41	0.53
16	0.32	42	0.66
19	0.5	43	0.3
20	0.43	44	0.62
21	4.28	54	0.6
24	0.18	56	3.7
26	0.008	62	0.42
27	0.01	65	0.36
28	0.07	67	0.29
29	0.07	73	0.14
30	0.47	75	1
31	0.15	78	0.67
35	0.56		

NOTE: Specific Capacities were calculated form short term pumping test data and are only approximations.

to the changing environment during deposition of the alluvium with the more coarse-grained materials associated with high energy outflows from Last Chance Gulch into the Ten Mile Creek drainage. As the groundwater moves out of the landfill area, to the north, the groundwater gradient flattens indicating more transmissive materials in this part of the valley.

Wells completed in bedrock southwest of the landfill exhibit much lower specific capacities (amount of water yield per foot of drawdown) than wells completed in the alluvium. Alluvial wells in the area are typically 60 to 100 feet deep, while bedrock wells are typically deeper than 250 feet. Water wells in and around the landfill area have been inventoried (Table 2.2) and are shown on Exhibit 1.

Semi-consolidated, alluvial deposits of Tertiary age were encountered north and west of the landfill during drilling of golf course irrigation well I-3 and monitoring well HL90-1 (Exhibit 1). These semi-consolidated deposits are less transmissive than the overlying, unconsolidated alluvium and are composed of calcite cemented sands and gravels sometimes referred to as "caliche".

The thickness of the alluvium increases from a few feet near Lyndale Avenue (see Exhibit 1) to about 200 feet at golf course well I-3. Figure 2.1 is a hydrogeological cross-section based on monitoring well data from the northern landfill boundary area. A steeper groundwater gradient (slope of the water table) near the city storm drain indicates a possible recharge and subsequent mounding effect from water associated with

Table 2.2: Helena Landfill Area Well Inventory

NUMBER	ADDRESS	OWNER	DEPTH	PERFORATED ZONE
1	230 Meadow Dr.	G. Amestoy	100	---
2	233 Meadow Dr.	C. Colarchic	---	---
3	227 Greenwood	A. Holzwarth	---	44-64
4	5 Deborah Ct.	T. Johnson	100	---
5	350 Custer Ave.	S. Colvin	80	60-80
6	3119 Bridger	J. Garman	100	70-100
7	454 Vigilante	R. Stenquist	51	---
8	3107 Vigilante	C. Knutson	101	80-100
9	3130 Vigilante	C. Tielking	61	---
10	448 Russell	L. Peterman	---	---
11	472 Russell	J. Zimmerman	---	---
12	448 Paxon	M. Parriman	68	60-68
13	102 Oakwood	E. Johnson	118	78-118
14	104 Oakwood	K. Rogers	115	70-110
15	106 Oakwood	E. Darfler	140	90-140
16	3 Parr Court	C. Tilzey	65	54-64
17	105 Wedgewood	F. Robinson	---	---
18	108 Wedgewood	B. Hartman	---	---
19	119 Wedgewood	D. Clark	115	90-115
20	3 Terry Court	H. Peterson	120	80-120
21	146 Briarwood	R. Karp	52	12-52
22	154 Briarwood	R. Burger	---	---
23	114 Ridgewood	T. Berry	75	55-75
24	1130 Waukesha	E. Johnson	180	100-180
25	1703 Waukesha	M. Carmichael	---	---
26	932 Peosta	G. Daly	300	---
27	1110 Peosta	S. McCann	360	---
28	1314 Peosta	M. Johnson	278	170-270
29	1331 Peosta	R. Guse	300	120-290
30	1611 Peosta	R. Brohman	135	---
31	1430 Brady	D. Gardner	101	75-95
32	1815 Brady	W. Routzahn	220	140-220
33	1317 Hudson	C. Engstedt	---	---
34	1325 Hudson	K. Erickson	118	78-118
35	1427 Broadwater Cir.	Broadwater Vill.	215	95-215
36	3203 Cooney	Kalamity Bros.	45	38-45
37	235 Anderson Blvd.	G. South	100	40-100
38	227 Anderson Blvd.	T. Tillo	100	40-100

--- Denotes information not found. Inventory is based on DNRC records and field investigation.

Table 2.2: Helena Landfill Area Well Inventory

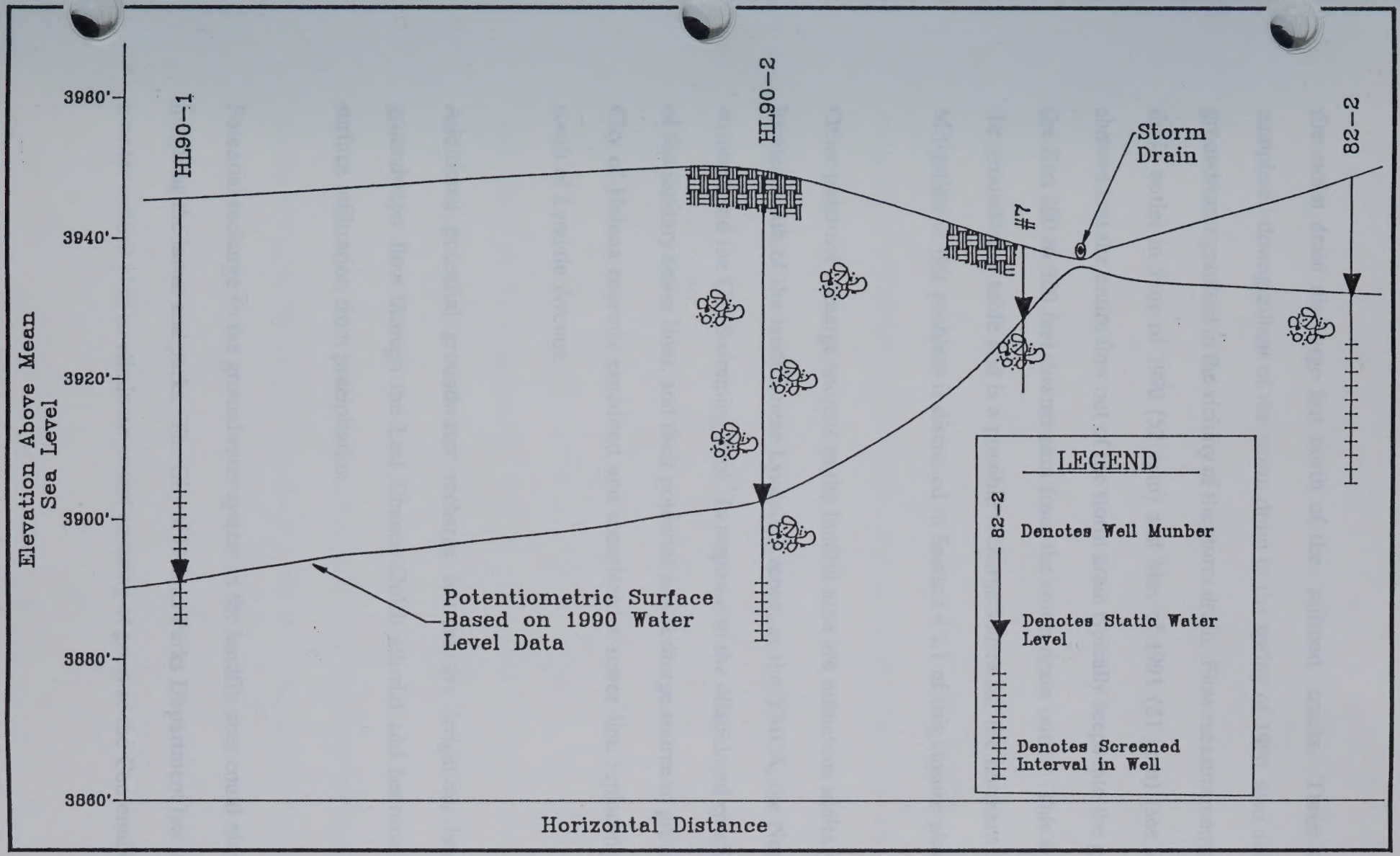
39	239 Anderson Blvd.	W. Kotan	82	58-82
40	2509 Teakwood	E. Hartman	70	50-70
41	124 Meadow	Strasko	73	53-73
42	112 Meadow	W. Hill	72	52-72
43	246 Brady	Frisch	80	40-80
44	1023 Peosta	Cumley	65	55-65
45	94 Oakwood	Hanson	116	---
46	320 Custer	Colvin	---	---
47	328 Custer	---	---	---
48	308 Custer	M. Barbeau	79	---
49	304 Custer	---	---	---
50	226 Custer	---	---	---
51	220 Custer	E. Hartze	64	---
52	Custer & Grn. Meadow	---	---	---
53	121 Dunbar	G. Kercher	---	---
54	122 Dunbar	S. Hitchcock	67	57-67
55	114 Dunbar	---	---	---
56	112 Dunbar	G. Francis	54	---
57	108 Dunbar	Bacon	---	---
58	106 Dunbar	---	---	---
59	100.102 Dunbar	B. Littlejohn	---	---
60	No Address - Trailers	---	---	---
61	78 Dunbar	J. Hayes	72	---
62	76 Dunbar	J. Bridges	80	60-80
63	110 Willow	G. Milairn	---	---
64	121 Willow	B. Bonogofsky	82	58-82
65	110 Willow	Pool	85	---
66	108 Willow	---	---	---
67	105 Willow	O'Neal	100	60-100
68	104 Willow	J. Creach	80-100	---
69	19 Willow	Horsecienda Hotel	---	---
70	11 Willow	Gardner	55	---
71	3204 Mitchell	Chamberlain	---	---
72	3208 Mitchell	Hall	---	---
73	3212 Mitchell	Tovey	72	52-72
74	3216 Mitchell	Allison	---	---
75	104 Reed	J. Creach	70	22-70
76	Trailer Court on Reed	---	---	---
77	115 Reed	---	---	---
78	120 Reed	W. Cole	50	42-50
79	SW Corner Grn Mdw/Reed	---	---	---
80	3280 Green Meadow	Trails West	---	---

--- Denotes information not found. Inventory is based on DNRC records and field investigation.

Table 2.2: Helena Landfill Area Well Inventory

81	3300 Green Meadow	G. M. Market	---	---
82	County Fairgrounds	Fairgrounds	---	---
83	610 W. Custer	AAA Car Wash	---	---
84	500 Cole Ave.	---	---	---
85	210 Harwood	Ralston	75	15-75
86	15 Reed	C. Bryant	72	---
HL-90-1	---	City of Helena	60	40-60
HL-90-2	---	City of Helena	68	60-68
HL-90-3	---	City of Helena	79	59-79
83-7	---	City of Helena	40	32-37
82-1	---	City of Helena	40	14-34
82-2	---	City of Helena	43	23-43
82-3	---	City of Helena	83	43-83
82-4	---	City of Helena	79	44-74
HL-1	---	EPA	---	---
HL-2	---	EPA	---	---
HL-5	---	EPA	---	---
HL-6	---	EPA	---	---
HL-7	---	EPA	---	---
EPA1	---	EPA	54.5	39.5-54.5
EPA2	---	EPA	55.1	40.1-55.1
EPA3	---	EPA	95	85-95
EPA4	---	EPA	76.2	66.2-76.2
I-1	---	Golf Course	146	35-95
I-2	---	Golf Course	---	---
I-3	---	Golf Course	220	71-170 (Zones)
I-4	---	Batch Fields	156	60-156
I-5	---	Carroll College	550	100-550
I-6	---	Carroll College	320	100-320
I-7	---	Golf Course	---	---

--- Denotes information not found. Inventory is based on DNRC records and field investigation.



Scale: Horizontal 1" = 300'
Vertical 1" = 20'

Figure 2.1: Hydrogeological Cross-Section Through Helena Landfill



the storm drain discharge just north of the railroad tracks. Three soil test pits, completed downgradient of the storm drain in the spring of 1990, also defined a steep groundwater gradient in the vicinity of the storm drain. Flow measurements at the storm drain outlet in June of 1990 (52 gpm) and May of 1991 (81 gpm) (see Appendix A) showed that the entire flow out of the storm drain typically seeps into the ground within the first 200 to 300 feet downstream from the storm drain outlet. This water mounds the groundwater table and is a possible recharge source for the northern landfill area. Mitigation of this problem is discussed in Section 4.1.1 of this closure plan.

Other potential recharge sources to the landfill area are numerous sanitary sewer lines located south of the landfill near Lyndale Avenue, at the YMCA, the National Guard Armory, and the City Swimming Pool. In response to the dilapidated condition of some of the sanitary sewer lines, and their potential as a recharge source to groundwater, the City of Helena recently expedited and completed a sewer line replacement program south of Lyndale Avenue.

Additional potential groundwater recharge sources are irrigation, lawn watering, groundwater flow through the Last Chance Gulch alluvial and bedrock system, and surface infiltration from precipitation.

Potential recharge to the groundwater system in the landfill area could also occur from irrigating the lawns and parks. The City of Helena Parks Department has implemented a water control plan to eliminate excess watering of grass at the Centennial park. The

water balance control plan involves evaporation and transpiration estimates using the Jensen-Haise (1963) ET method, soil moisture monitoring, estimating moisture input from rainfall and irrigation, and water system malfunction checks.

2.3 WATER QUALITY

Many groundwater and surface water quality samples have been obtained in the vicinity of the Helena landfill over the past 13 years. These samples have been analyzed for both organic and inorganic parameters. Most historic data are for inorganic parameters since earlier regulations did not require organic analysis. Appendix A is a compilation of water quality data obtained from the Helena landfill area. The raw laboratory data are included in Appendix B. Additional water quality data are available in EPA's 1987 and 1989 reports. These data are not included because the EPA results showed obvious quality control problems and the results are not considered representative of actual groundwater conditions.

2.3.1 Organic Water Quality

In 1987 and 1989, EPA investigated the Helena landfill site and concluded that site problems were not sufficiently severe to place the site on the National Priority List (NPL). However, EPA analytical results suggested that low levels of organic compounds may be present in the vicinity of the landfill. Additional sampling by Hydrometrics, Inc., in the fall of 1989 and spring of 1990 and 1991 confirmed the presence of very low concentrations of volatile organic compounds (VOCs) beneath and peripheral to the landfill. Table 2.3 summarizes the types, chemical properties and uses of those VOCs

detected. The analytical methods used to measure the concentration of VOCs in the groundwater were EPA Method 502.2, EPA Method 624, and EPA Method 625 (regulated and unregulated VOCs) for semi-volatile organic compounds. A total of 53 VOC samples and 3 semi-volatile samples were obtained and analyzed from monitoring wells, domestic wells and irrigation wells during this investigation.

Results of groundwater sampling and testing (Appendix B) showed VOCs are present in several wells. Table 2.4 shows the EPA maximum contaminant levels (MCLs) for each compound in drinking water supplies.

The following summarizes the extent of organics in groundwater in the study area.

1) A total of 39 domestic, irrigation and monitoring wells northwest of the landfill area were sampled to determine water quality and 22 wells were surveyed to determine groundwater elevations. Based on this survey and a water level map, it has been determined that groundwater is generally flowing northwest from the landfill through sandy, silty, gravelly strata.

2) Groundwater samples obtained from several domestic wells (potable supplies) were analyzed for volatile organic compounds (VOCs). Results of these analyses show the levels of all VOCs are lower than levels established by the EPA as maximum contaminant levels (MCLs) for listed priority compounds. A listed priority compound is a compound that EPA

TABLE 2.3 TYPICAL USES AND PROPERTIES OF THOSE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER

1) 1,1 Dichloroethane, or ethylidene chloride (CH_3CHCl_2), is a mobile liquid that is colorless and sparingly soluble in water. Some common uses are an extraction solvent and a fumigant.

2) Tetrachloroethane, or perchloroethylene ($Cl_2C{:}CCl_2$), is a stable, colorless liquid that is nearly insoluble in water. Some common uses are for dry cleaning and as a degreasing solvent.

3) 1,1,1 Trichloroethane, or methyl chloroform (CH_3CCl_3), is a colorless liquid, nearly insoluble in water. Common uses are metal degreasing, an ingredient in pesticides, textile processing and as a solvent for cleaning precision instruments.

4) Trichloroethene, or (tri), (CH:CCl2), is a stable, photoreactive liquid slightly soluble in water. It is used as a metal degreaser, a diluent in paints, a refrigerant and for dry cleaning.

5) Chloroform ($CHCl_3$) is colorless and heavily reactive with a characteristic odor. It is used in analytical chemistry, as a solvent, as an expansion agent in styrofoam and as a fumigant.

6) Dichloromonofluoromethane, or Freon 21, ($CHCl_2F$) is a colorless, nearly odorless, heavy gas. It is used as a refrigerant and as a solvent.

7,8) Cis or Trans 1, 2-Dichloroethene ($ClHC{:}CHCl_2$), is a colorless, low-boiling point liquid that exists in Cis and Trans isomers. It is slightly soluble in water and is used as a solvent, in lacquers, perfumes and thermoplastics.

9) 1,2 Dichloropropane, or propylene dichloride ($CH_3CHClCH_2Cl$), is a colorless stable liquid with a chloroform odor, nearly insoluble in water. It is used as a spotting agent, metal degreaser, soil fumigant for nematodes and a scouring compound.

10) Methylene chloride, or dichloromethane (CH_2CL_2), is a colorless volatile liquid with an ether-like odor. It is slightly soluble in water and is used commonly for laboratory cleaning, a solvent for degreasing and a paint remover.

11) Dichlorodifluoromethane or fluorocarbon-12 (CCl_2F_2), is a colorless non-corrosive gas, nearly insoluble in water. Common uses are as an aerosol propellant and refrigerant.

12) Trichlorofluoromethane or fluorocarbon-11 (CCl_3F) is a colorless nearly odorless volatile liquid and is used as an aerosol propellant, solvent and in fire extinguishers.

Source: Sax and Lewis, 1987

TABLE 2.4 VOLATILE ORGANIC COMPOUND MAXIMUM CONTAMINANT LEVELS HELENA LANDFILL

Constituent	EPA Maximum Contaminant Level (MCL) Parts Per Billion (PPB)	Highest Concentration Found in any water well Parts per Billion (PPB)
Dichlorodifluoromethane	Not Listed	6.6
Trichlorofluoromethane	Not Listed	<1.0*
1,1-Dichloroethene	7.0	<.50*
Methylene Chloride	5.0 (proposed)	1.1
1,1-Dichloroethane	Not Listed	1.5
Cis-1,2-Dichloroethene	70.0	2.0
Chloroform, Dibromomethane, Bromodichloromethane, Bromomethane	100.0 (for the sum of all)	11.0
1,1,1-Trichloroethane	200.0	1.9
Tetrachloroethane	5.0	8.1
Trichloroethene	5.0	1.8

*Present but less than the method detection limit.

has identified because of its potential toxicological effects, and has set a maximum concentration which cannot be exceeded for drinking water.

3) Several VOCs were detected in irrigation wells northwest of the landfill. The concentrations of these compounds are very low (less than 10 parts per billion). With the exception of tetrachloroethane, no VOC concentration was above the EPA MCL for the irrigation wells tested. Tetrachloroethane was detected in wells upgradient of the landfill as well as wells downgradient of the landfill. This indicates the landfill is likely not the only source of the tetrachloroethane. The maximum concentration of tetrachloroethane detected in any irrigation well was 8.1 parts per billion, which is 3.1 parts per billion above the MCL. The EPA criteria for determining the MCL for VOCs is based on consumption of two liters of water per day. Tetrachloroethane concentrations exceeded the EPA MCL in four irrigation wells. No potable water supply well tested showed tetrachloroethane levels above the EPA MCL.

4) Three VOCs, not listed by the EPA as priority compounds (Table 2.4), were detected in various wells. Because EPA does not considered these priority compounds, there has been no EPA maximum contaminant level established for these compounds. However, EPA has set maximum concentration limits for various known and suspected toxic and

carcinogenic compounds at a level higher than the concentrations of these non-priority compounds detected near the landfill. It is anticipated that when EPA limits are established for these non-priority compounds, these limits will be higher than the concentrations of the compounds present in the tested wells.

5) All other testing of water from irrigation and potable water supply wells show levels of organic and inorganic constituents are lower than the EPA MCLs.

Exhibit 2, shows the approximate lateral extent of selected organic compounds in the groundwater based on 1991 sampling events. Dichlorodifluoromethane was selected as the parameter to be plotted because of its relatively low retardation factor and because it is a common landfill contaminate. Dichlorodifluoromethane is a fluorocarbon used most extensively as an aerosol propellant for hair sprays, deodorants and many other household products. In addition, it is used as a refrigerant. The retardation coefficient for dichlorodifluoromethane in this alluvial system is approximately 1.6, or, groundwater can be expected to move 1.6 feet for every 1 foot dichlorodifluoromethane moves in the groundwater system. This difference in travel rates between groundwater and VOCs such as dichlorodifluoromethane is due to their affinity for soil particles (especially organic soil), and therefore the VOCs move at velocities less than the groundwater. Calculations for the retardation coefficient of dichlorodifluoromethane are shown in Table 2.5.

In addition to retardation, other attenuation mechanisms decrease the concentration of organic compounds as they move through the groundwater away from the source of contamination. These mechanisms are dispersion or lateral spreading of the compound, and degradation (both chemical and by micro-organisms). It is difficult to determine exactly how much effect each of these attenuation mechanisms has on a solute because many factors such as solute concentration, aquifer characteristics, and geochemical factors are involved.

A sanitary landfill has a relatively simple mechanism of leachate production. In general, water percolates into, or is initially present in landfill refuse and creates a solute or a leachate. Residual water and chemicals present during landfilling could include partially filled containers of paint, lacquer, cleaning fluids, aerosols, plastics, organic products and free liquid chemicals. Containers either break and release the chemicals immediately, or slowly rust and release the chemicals over time. Additional landfilled chemicals could include pesticides, fumigants, fuels, oils and many others (Sax and Lewis, 1987).

Some of the chemical compounds commonly found in landfill leachate are dichlorodifluoromethane, trichlorofluoromethane, trichloroethane, 1-2-dichloroethene, methylene chloride and tetrachloroethane. Dichlorodifluoromethane and trichlorofluoromethane were commonly used as aerosol propellants (Table 2.3). 1-2-Dichloroethene (both in cis and trans isomers) is commonly used as a household lacquer and trichloroethene is commonly used to dilute paint. Methylene chloride is commonly

TABLE 2.5 RETARDATION OF DICHLORODIFLUOROMETHANE

Aquifer Characteristics

% Organic Carbon	=	0.06 Calculated
% SOM	=	0.10
Bulk density	=	1.72 Calculated
Porosity	=	0.35

Chemical Compound

Dichlorodifluoromethane

Solubility equation used was log Koc	=	3.64 + .55 * -Log 280
Solubility	=	0.28E + 03 mg/l
Log Solubility	=	2.45

(Solubility was entered into program as 280 mg/l)

Koc	=	0.20E + 03
Log Koc	=	2.29
Retardation Coefficient	=	1.6
Rf value	=	0.6403

Solubility equivalents based on molecular weight of 120.92

mg/l	micromoles/l	mole fraction
0.2800E + 03	0.2316E + 04	0.4171E -04

Logs of above solubilities

2.4472	3.3647	-4.3797

Source: Oklahoma State University, Dr. Hanslow, 1988.

used as a paint remover. Tetrachloroethane is used in dry cleaning and as a degreasing solvent. The production of tetrachloroethane alone exceeded 300 thousand tons per year in the United States in 1982 (Moore and Ramamoorthy, 1984).

In addition to landfill leachate generation, additional sources of organic compounds present in the groundwater in the vicinity of the landfill are likely. Irrigation wells near the landfill were sampled and showed low levels of tetrachloroethane and chloroform. These include wells 28, 34 and 24 (see Exhibit 1). A source of organic contaminants upgradient of these wells is likely adding to the low levels of organic compounds in the groundwater. The source of these compounds is unknown however, dry cleaners, service stations or other industrial facilities in the Euclid Avenue area could be the potential source of the low levels of tetrachloroethane. Chloroform (and the low levels of other trihalomethanes) in the groundwater could be partially the result of lawn watering with City of Helena water or leaky sanitary sewer lines. Analysis showed concentrations of trihalomethanes in three city water samples below the EPA MCL, but were in the 90 parts per billion range, which is well above any concentrations found in the groundwater.

In addition to trihalomethanes in city water, chlorinated water discharged in sanitary sewers from the YMCA and city pool could seep into the groundwater and create chloroform. Humic and fulvic acids (commonly present in organic soils) have the required structural and functional arrangements for a haloform reaction (Moore and Ramamoorthy, 1984). Sanitary sewer pipes from the city pool are designated by the City

as class 2 pipelines. The classification system ranges from Class 1, sewage pipes that are heavily dilapidated, to class 5, sewage pipes that have been recently replaced.

As discussed in Section 2.2, the city storm drain is likely creating a groundwater mound in the landfill area. A portion of this groundwater could be percolating through refuse, and it also may initially contain organic compounds from the storm drainage area which is Last Chance Gulch. Samples of this storm drain water obtained previously by EPA showed low levels of VOCs.

Generally, storm drainage is poor in quality because it contains street runoff which significantly degrades water. In addition, there could possibly be illegal discharges into city drains. Sanitary sewer pipes upgradient of monitoring well HL-1 are in poor condition and are designated by the City as class 1 pipes. These pipes were installed in the late 1800s and are dilapidated. A water sample obtained from monitoring well HL-1 and analyzed for coliform bacteria (a bacteria present in the feces of warm blooded animals) showed significant contamination. Because of this problem, these dilapidated pipes were placed on an expedited replacement plan by the City.

2.3.2 Inorganic Water Quality

Inorganic water quality beneath and peripheral to the Helena landfill (Appendix B) also indicates a plume is present. Chloride concentrations and specific conductivity are elevated in the landfill vicinity and decrease in concentration downgradient of the landfill. The total dissolved solids concentration in groundwater in the landfill vicinity

(Appendix B) is slightly higher than the secondary drinking water standard of 500 mg/l. Nitrate plus nitrite is present in groundwater in several wells and has historically exceeded 10 mg/l in monitoring wells completed in the landfill (Appendix B). Concentrations of other major minerals appear to be elevated in the vicinity of the landfill. These excavated levels are likely due to the landfill as well as other upgradient sources. Concentrations of dissolved metals in the groundwater show no apparent water quality change in the vicinity of or downgradient of the landfill.

3.0 COVER SOIL

The type of soil used for covering landfill refuse is very important in controlling landfill leachate. The cover soil used for the City of Helena Landfill closure meets all requirements set forth by the State of Montana (ARM Title 16, Chapter 14, Subchapter 5, Section 16.14.521 (2), and the MDHES document of April 3, 1991, entitled "Class II Landfill Closure Requirements and Recommendations".

3.1 SOURCES AND PHYSICAL CHARACTERISTICS OF THE COVER SOIL

Two cover soil sources are being utilized in the final cover for the City of Helena Landfill. These two sources are the landfill site itself, and the City of Helena Retention Basin area located north of K-Mart along Interstate 15. These two sources will be discussed in detail, individually in the following sections.

3.1.1 Helena Landfill Area Soil

The eastern portion of the landfill (landfill cells 2 through 16) have been covered and reseeded since 1987. The cover soil used to cover this portion is landfill area soil that was stockpiled during the excavation of landfill cells. A 1982, Hydrometrics report entitled "Soils Evaluation of the City of Helena Landfill Area" identified the landfill area soils as loams falling within the GM, ML and SM categories of the Unified Soil Classification System. The Administrative Rules of Montana (ARM 16.14.505) defines these soil types as typically having permeabilities ranging from 10^{-6} to 10^{-3} cm/sec. Double ring infiltrometer tests on these in-place cover soil showed permeabilities of the

cover ranging from 4.4×10^{-4} to 3.6×10^{-5} cm/sec. All values were well below the 1×10^{-3} cm/sec requirement set forth by the MDHES. Figure 3.1 shows the locations of the double ring infiltration tests. The double ring infiltrometer tests are included in Appendix C.

Soil samples collected from the landfill site in 1990 and 1991 have been analyzed in a laboratory for particle size distribution and permeability. The sample locations are shown on Figure 3.1 and lab results are included in Appendix C. The particle size analyses showed that the soils are sandy, gravelly loam with a large clay and silt fraction. The clay and silt fraction for the samples ranged from 17 to 31 percent. This large percentage of fine materials controls the hydraulic properties of the soil resulting in relatively low permeabilities. A laboratory permeability test performed on a sample taken from the landfill site in 1989 showed a permeability of 5.8×10^{-6} cm/sec for the soil (Appendix C).

3.1.2 City of Helena Retention Basin Area Soils

The western portion of the landfill, cells 1 and 17 through 20, will be covered with soils borrowed from the City of Helena Retention Pond Basin excavations located north of K-Mart along Interstate 15. The majority of the soil in this area is a gravelly loam similar to that at the landfill site. A red clay-rich sand with very few gravels is also present interbedded with the gravelly loam.

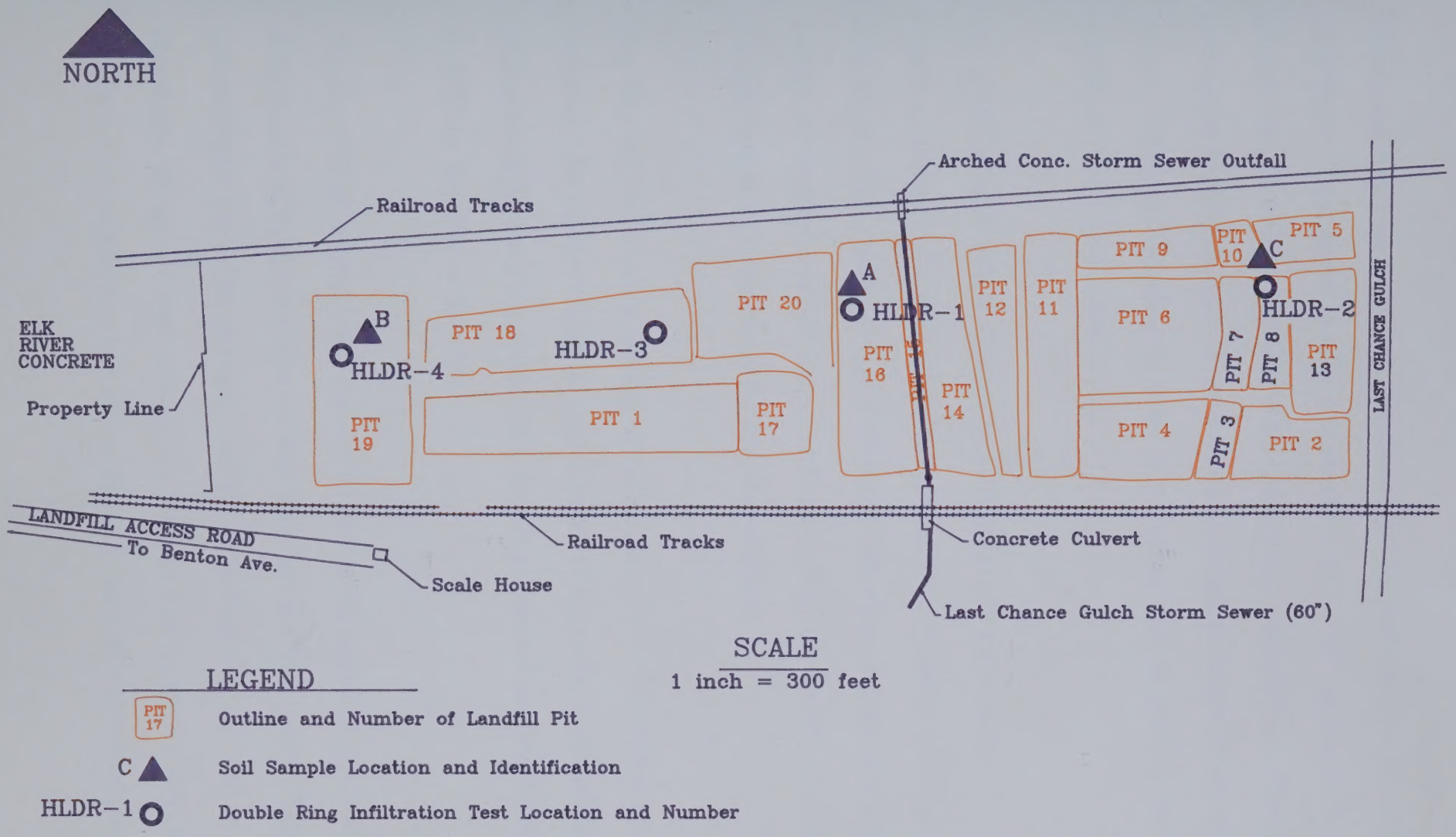


Figure 3.1: Location of Double Ring Infiltration Tests and Soil Samples

Double ring infiltrometer tests were performed on both of these soils. The gravelly loam soil (RPDR-2) was shown to have a permeability of 3×10^{-4} cm/sec, while the clayey sand (RPDR-1) had a permeability of 8.1×10^{-5} cm/sec (Appendix C). These tests show that both soils would be suitable for use as a cover soil, however the City is separating the two soils and stockpiling as much of the clayey sand as possible for use in the uppermost portion of the final cover.

3.2 COVER SOIL REQUIREMENTS AND QUALITY CONTROL

Montana Administrative Rule ARM 16.14.521 and the MDHES document of April 3, 1991 require that at least two feet of cover soil with a permeability of less than 1×10^{-3} cm/sec be applied over all areas which have received landfill materials. These requirements will be ensured by the following methods.

The City has performed a number of infiltrometer tests for internal quality control measures. The results of these tests are included in Appendix C. All infiltrometer tests performed on the cover soils have shown the soil to meet the permeability requirements set forth by the State of Montana.

The depth of all in-place cover soil will be verified by physical inspection of site area using excavating equipment after the final cover soil has been placed. The excavations will be spaced 100 to 200 feet apart and will be at least two feet deep or to the cover soil/refuse contact. If cover soils of less than two feet are found, these areas will be delineated and additional cover will be added to meet the two foot requirement.

4.0 FINAL COVER DESIGN

The final cover for the City of Helena Landfill has been designed as per the State of Montana Class II Landfill Closure Requirements and Recommendations (April 3, 1991). Proposed future land use, maintenance and monitoring have all been considered in the final cover design.

4.1 DRAINAGE - RUNON/RUNOFF PLAN

Exhibit 3 shows the final grading and drainage plan for the completed cover on the Helena Landfill. This plan allows precipitation to runoff quickly and efficiently away from all areas which contain buried refuse. The cover topography of the landfill, and the drainage ditch system peripheral to the landfill were designed to eliminate surface runon. Runoff from the Last Chance Gulch area, however, drains under the landfill in the city storm drain running below the landfill. To eliminate potential recharge due to the landfill from this source, the drain will be extended to discharge further away from the landfilled areas. This extension is detailed in Section 4.1.1 of this closure plan.

This drainage plan incorporates the drainage plan designed by Damschen and Associates for the proposed transfer station to be located at the present landfill site. This is contingent on the permitting process for the transfer facility and the proposed new Lewis and Clark County Landfill located northeast of Helena.

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4.1.1 Extension of the City Storm Drain

Springtime flows for the Last Chance Gulch area storm drain outfall located just north of the landfill were measured in 1990 and 1991. These flow measurements are shown in Appendix A. Flows from the outfall ranged from 52 gallons per minute (gpm) to 81 gpm and all flow typically percolates into the ground within the first 200 feet of the channel below the outfall. This channel is excavated to the north of the landfill along the east side of Bill Roberts Golf Course. The water which seeps into the ground causes a mounding effect on the local water table that could potentially saturate refuse or recharge the aquifer with poor quality storm runoff water.

Figure 4.1 is a cross-section which shows the mounded water table (under high water table conditions) and its relationship to the landfill cell area. This cross-section suggests that the northwest corner of the landfill cell number 18 has the highest potential to be impacted by the mounded water table. It is important to note that several assumptions have been made in the preparation of this cross-section. These assumptions are outlined as follows:

1. That the outfall from the storm drain is essentially a point recharge to the groundwater system. This requires that the storm drain running beneath the landfill is competent and that no leakage occurs. The storm drain was inspected by city workers in 1990 (personal communication, Dick Nisbet, May 1991) and no leakage was observed in the concrete section above the location of the outfall near the northern most railroad track (Exhibit 1).

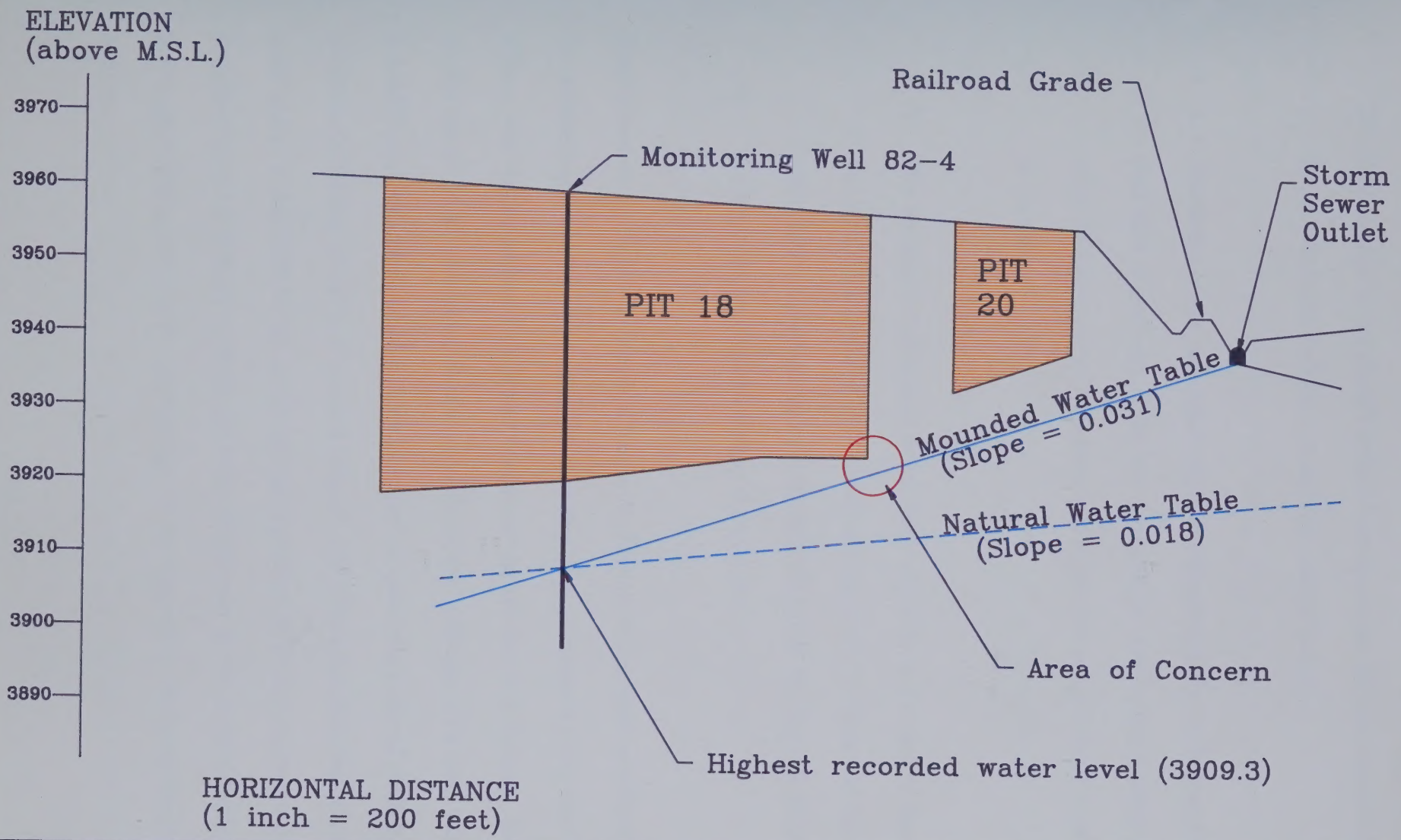


Figure 4.1: Cross-Section of Storm Sewer Outfall Area

2. The aquifer in the outfall area is homogeneous and the mounding the water table is uniform radially around the outfall "point".

3. The slope of the mounded water table between the outfall and monitoring well 82-4 is uniform. This is a conservative assumption because the water table is likely parabolic in shape and would not actually have as much impact as assumed.

4. The natural (unmounted) water table gradient in the outfall area would be similar to that north of the landfill outside of the influence of the mounding. Materials in monitoring well HL-90-1 north of the landfill were similar to those in HL-90-2 located near the outfall.

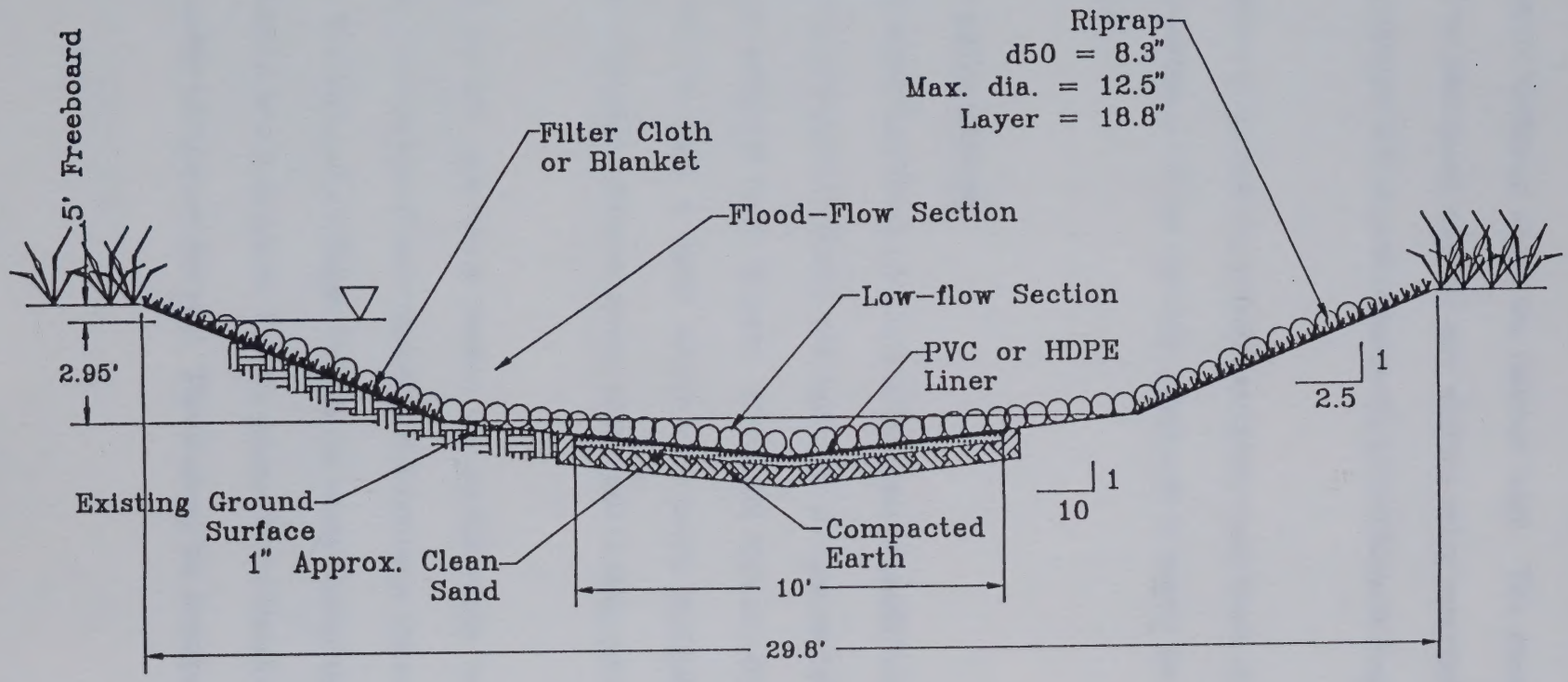
The cross-section shown in Figure 4.1 uses the highest water table condition on record for monitoring well 82-4. The water level at that time of measurement, with mounding effects, was within several feet of the bottom of the refuse. It is possible that capillary action could have caused moisture to contact the garbage. To help alleviate this potential problem, the City of Helena proposes to move the point of recharge from the storm drain downgradient to a location where it will have a minimal impact on the water table under the landfill. This would be accomplished by lining the storm drain outfall for approximately 600 feet before the water discharges to the natural unlined channel where percolation can occur. The design of the channel is discussed in the following section.

4.1.2 Design of Storm Drain Extension

The channel extension consists of a two-phase channel design, including a low-flow channel designed to pass base flows and an artificial flood-plain terrace to pass flood flow. The overall length of the new section of channel is approximately 500 feet with a slope of 0.015 ft/ft. The estimated base or low design flow is approximately 0.5 cfs (cubic feet per second) or 225 gpm (gallons per minute). The design flood flow value is 391 cfs which is derived from the flow capacity of the immediately upstream culvert that discharges to the new channel.

The low-flow section of channel is triangular in shape, has a maximum flow depth of 0.5 feet, 10 to 1 side slopes and has a top width of 10 feet. The artificial flood-plain section is trapezoidal in shape, has a maximum flow depth of 2.95 feet, 2.5 to 1 side slopes and has a top width of 24.8 feet. Riprap will be used in both channel phases and will have a d^{50} of 8.3 inches. The maximum riprap diameter is 12.5 inches and the riprap layer thickness is 18 inches.

The Manning's roughness coefficients used for the channel design was increased by 10% to allow for suspended material and debris, plus increased bedload volumes accompanying flood flows. This in effect calls for a deeper channel, thus ensuring containment of flood flows. A design safety factor of 1.5 was applied for channel freeboard. The design freeboard is 0.5 feet, bringing the total channel depth to 3.95 feet with a total top width of 29.8 feet. Flow regimes in both phases are subcritical. A schematic of the two-phase channel design is shown on Figure 4.2 and the calculations



Not To Scale

HLF20-91

Figure 4.2: Storm Sewer Extension Cross-Section

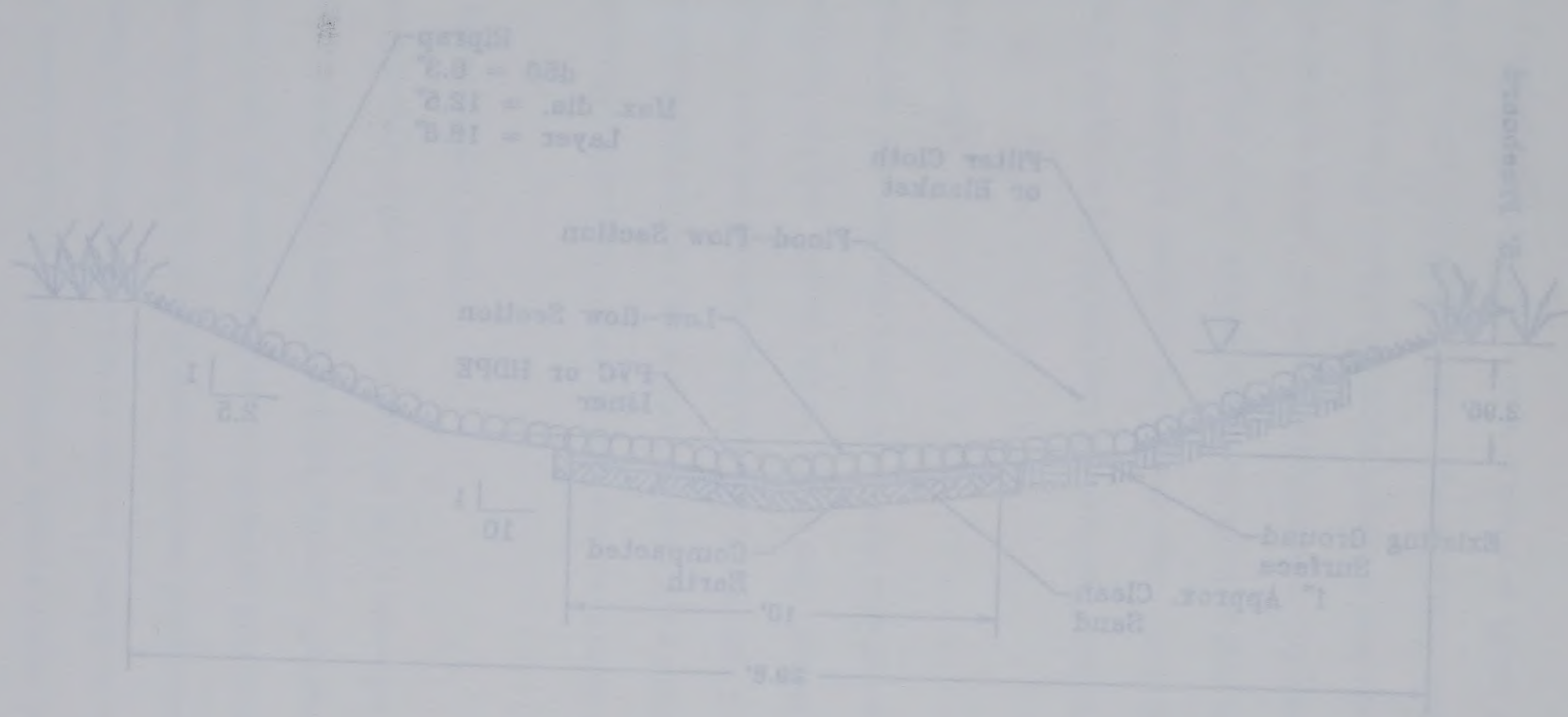


Figure 4.2: Storm Sewer Extension
Cross-Section

are shown in Table 4.1. The new channel is designed to extend 390 feet from the existing concrete bulkhead under the railroad track. The meanders of the previous channel will be eliminated with the new channel being essentially straight. The final design of the channel will be performed by the City of Helena Engineering Department.

After completion of the new storm drain extension, water levels in peripheral monitoring wells and piezometers will be carefully monitored to assess the impacts of the storm drain extension.

4.2 VEGETATIVE COVER

Revegetation of the landfill area is a very critical part of landfill closure operations. The vegetation and subsequent landfill soil type are the parameters most important in maintaining an adequate water balance. If the soil does not store enough water, the vegetation will not have a water source and heavy precipitation events or the accumulation of several moderate events could lead to deep percolation of water.

Two feet of the soil specifically chosen for landfill cover by the City will store approximately 3 to 5 inches of water based on SCS estimates (Montana Irrigation Guide, SCS, 1988). This will provide buffer storage for heavy precipitation periods while the vegetation uses the stored moisture. Pasture grasses in the Helena area (SCS, 1988) can use up to 21 inches of moisture per year. This is above the average annual precipitation.

TABLE 4.1 CHANNEL DESIGN CALCULATIONS

CITY OF HELENA
Helena Landfill Project

HYDROLOGY
Channel Design

Parameters	Value	Unit	Source
[illegible] of channel	490	ft	Air photo
[illegible] channel	0.0148	ft/ft	Bulkhead outlet - midway between sections 8 & 9
[illegible]se flow	0.446	cfs	Estimated
	200	gpm	
[illegible]n flood flow	391	cfs	Capacity of 60" R.C.P.

Channel Capacity Calculations

I. RIPRAP CALCULATIONS

1. $d50 = 12 (118 Q Sb^{13/6} r/p)^{2/5}$
   where Q = discharge
   Sb = channel slope
   r = Hydraulic radius
   p = wetted perimeter
   $d50 = [(12)(118)(391)(0.0148)^{13/6} (0.0805)]^{2/5}$
   = 8.3 inches

2. Maximum diameter = 1.5 (d50)
   = 12.5 inches

3. Minimum Layer
   Thickness = 1.5 (dmax)
   = 18.8 inches

4. Riprap up side to maximum expected depth of flow

5. A filter cloth should be used underlying the riprap, or a filter blanket using:

   $\frac{d\ 15\ \text{rirprap}}{d\ 85\ \text{filter}} <= 5$; $\frac{d\ 15\ \text{filter}}{d\ 85\ \text{base}} <= 5$

SOURCE: EPA, 1976. Erosion and Sediment Control.

II. MANNING'S N CALCULATION

1. Manning's $n = 0.0395\ (d50)^{1/6}$, where d50 in feet

   $n = 0.0395 (0.67)^{1/6}$
   = 0.0372

   SOURCE: EPA, 1976. Erosion and Sediment Control.

2. Design safety factor - increase Manning's n by 10%

   n = 1.10 n
   = 1.10 (0.0372)
   = 0.041

   SOURCE: CIVIL ENGINEERING, January 1990. "Rethinking Flood-Control Channel Design".

III. CHANNEL DESIGN

1. Channel shape

   Two-stage flow-channel design:
   - low-flow channel designed to pass base flow
   - artificial flood-plain terrace designed to pass flood flow

2. Channel Design

Section	Shape	Channel Slope (ft/ft)	Side Slope (H:1V)	Bottom Width (ft)	Manni n	Flow depth (ft)	Flow Area (ft^2)	Wetted Perimeter (ft)	Calc Flow (cfs)	Top Width (ft)	Avg Velocity (fps)	Frude Number
Base	Tri	0.0148	10	NA	0.041	0.50	2.50	10.05	4.37	10.0	1.7	0.62
Flood	Trap	0.0148	2.5	10	0.041	2.95	53.76	25.94	386.35	24.8	7.2	0.86
Depth in low-flow channel at design low-flow q =						0.21						
Total						3.45			390.72	24.8		
With freeboard using safety factor = 1.5						3.95				29.8		

SOURCE: Manning's Equation for Open Channel Flow. Chow, 1964.
CIVIL ENGINEERING, January 1990. "Rethinking Flood-Control Channel Design".

Based on conversations with the SCS and recommendations from Nate Halubka, who has extensive experience with reseeding reclaimed areas as an employee with Grasslands, Inc., the following seed mix per acre is suggested:

5 lbs fairway crested wheatgrass

5 lbs durar hard fescue

2.5 lbs slender wheatgrass

3.5 lbs Canada wheatgrass

This seed mixture is based on the drill seeding method, if broadcast seeding is required, the seed mixture will have to be doubled. This vegetation plan is also contingent on the final usage for the reclaimed landfill site. Any changes in the vegetation plan will be submitted to the MDHES for approval before being implemented. Potential future usage of the reclaimed landfill is discussed in Section 7.0 of this closure plan.

5.0 CLOSURE CERTIFICATION

Prior to final closure of the Helena Landfill, the City of Helena will notify users via public announcement, and an alternative disposal facility will be named. It is anticipated that the alternative facility will be the new Lewis and Clark County Landfill in conjunction with the transfer facility to be located at the present City of Helena Landfill site. This closure plan will also be made available for public inspection. Access will be restricted to all areas to prevent refuse disposal and cover damage. Access will only be allowed to the transfer station once it becomes operational.

The landfill closure shall be considered an "interim closure" until it is approved in writing by a solid waste program inspector from the Solid and Hazardous Waste Bureau of the Montana Department of Health and Environmental Sciences. When such notice is given, the landfill will be declared officially closed and the City of Helena shall surrender their Solid Waste Management System License for this site to the MDHES. The time schedule for the final closure activities is dependent on the opening date for the new Lewis and Clark County Landfill facility.

6.0 POST CLOSURE MAINTENANCE AND MONITORING

Post closure maintenance and monitoring are necessary to ensure the long term integrity of the landfill cover. This post closure maintenance and monitoring plan fulfills the requirements set forth by the State of Montana's Class II Landfill Closure Requirements and Recommendations (April 3, 1991).

6.1 VISUAL INSPECTION - EROSION, SETTLING AND VEGETATION CONTROL

The landfill cover and drainage ditch system will be inspected annually and after major rain events to determine its integrity. The inspection will consist of checking for erosion, differential settling, and washing out of vegetation. Rills forming in the cover will be repaired to original grade and reseeded. Erosion controls such as geofabrics, straw dams, etc. amy be implemented to control problem areas.

The cover will also be inspected for extensive differential settling. Differential settling could potentially result in ponded areas on the landfill cover, resulting in leachate production. Problem areas will be regraded to original grade and reseeded.

Drainage ditches will also be maintained after the landfill is closed. Ditches will be inspected for excessive erosion and erosion will be controlled with riprap, liners, or other acceptable measures. Culverts will be cleaned when necessary to maintain proper flow in the ditches.

Repairs to the landfill cover and ditches will be performed as soon as possible after problems are discovered to avoid major damage to the cover. Small problems such as erosional rills and washed out vegetation can be handled very quickly, whereas larger problems may require more investigation and design to mitigate.

This visual inspection portion of the post-closure maintenance and monitoring plan will be ongoing until such time as the MDHES deems necessary to ensure that conditions are stable and potential for problems is minimized.

6.2 GROUNDWATER MONITORING

This post-closure groundwater monitoring plan fulfills the requirements as set forth by the State of Montana Administrative Rules, Title 16, Chapter 14, Sub-Chapter 7 - Proposed Groundwater Monitoring Rules For Landfills in Montana, and the Montana Class II Landfill Closure Requirements and Recommendations (April 3, 1991).

The proposed water quality sampling schedule for the City of Helena Landfill (Table 6.1) incorporates the comments of the MDHES and the City/County Health Department. Parameters that would be analyzed are in the analytical schedule on Table 6.2. The parameter list is based on the draft landfill groundwater monitoring requirements being developed by MDHES.

All samples will be obtained using documented and accepted sampling techniques. One duplicate and one blank sample will be obtained and analyzed per sampling event for

TABLE 6.1 WATER QUALITY ANALYTICAL SCHEDULE

Well Number	Analysis	Date
83-6 no such well?	Phase I Parameters	Spring, Fall
HL90-1 Batch fields	Phase I Parameters	Spring, Fall
HL90-2 NE of landfill	Phase I Parameters	Spring, Fall
HL90-3 by access road to scale house	Phase I Parameters	Spring, Fall
40 Teachwood Lane	Phase I VOCs	Spring, Fall
31 Off Brady St.	Phase I VOCs	Spring, Fall
5 At junction of Benton and Custa Ave.	Phase I VOCs	Spring, Fall
13 Oakwood Ln.	Phase I VOCs	Spring, Fall
75 Mitchell Ave.	Phase I VOCs	Spring, Fall
EPA-1 Site by overpass on LC Gulch	Phase I VOCs	Spring, Fall
59 Dunbar Rd	Phase I VOCs	Spring, Fall
52 Off Custa Avenue by Greenmeadow Dr.	Phase I VOCs	Spring, Fall

Note: Because private well are sometimes difficult to access, nearby wells may be substituted, if necessary.

TABLE 6.2 GROUNDWATER MONITORING PARAMETERS

1. Ammonia (as N)
2. Bicarbonate (HCO_3)
3. Calcium
4. Carbonate
5. Chloride
6. Iron
7. Magnesium
8. Manganese, dissolved
9. Nitrate (as N)
10. Potassium
11. Sodium
12. Sulfate (SO_4)
13. Chemical Oxygen Demand COD)
14. Total Dissolved Solids
15. Total Suspended Solids
16. Specific Conductance
17. pH
18. Arsenic
19. Barium
20. Cadmium
21. Chromium
22. Cyanide
23. Lead
24. Mercury
25. Selenium
26. Silver

27. The following volatile organic compounds (VOCs by EPA Method 8240):

- Benzene
- Bromochloromethane
- Bromodichloromethane
- cis-1,3-Dichloropropene
- Trans-1,3-Dichloropropene
- 1,4-Difluorobenzene
- Ethylbenzene
- Ethyl methacrylate
- 4-Bromofluorobenzene
- Bromoform
- Bromomethane
- Carbon tetrachloride
- Chlorobenzene
- Chlorodibromomethane
- Chloroethane
- 2-Chloroethyl vinyl ether
- Chloroform
- Chloromethane
- Dibromomethane
- Dichlorodifluoromethane
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- Iodomethane
- Methylene chloride
- 1,1-Dichloroethene
- trans-1,2-Dichloroethane
- Styrene
- 1,1,2,2-Tetrachloroethane
- Toluene
- 1,1,1-Trichloroethane
- 1,1,2-Trichloroethane
- Trichloroethene
- Trichlorofluoromethane
- 1,2,3-Trichloropropane
- Vinyl acetate
- Vinyl chloride
- Xylene

NOTE: Phase I parameters include all parameters listed above.
Phase I VOC's include parameters listed in item number 27.

quality control and quality assurance. Monitoring results will be submitted to the MDHES and City/County Health Department when the results are obtained and validated.

6.3 METHANE MONITORING

Methane monitoring in the vicinity of the Helena Landfill has been carried out by the Helena Fire Department since the early 1980s through 1990. This monitoring consisted of combustible gas surveys in monitoring wells HL-1 through HL-7 and the basements of the YMCA and State Armory Buildings. During this time the highest concentrations of methane were observed in well HL-4 and range from 2.2 to 6.4% (personal communication, Fritz Zettal, City of Helena Fire Department, January 1990).

At the request of MDHES, a new program encompassing the northern part of the landfill area was implemented in Spring 1991. The Helena Fire Department sampled the YMCA and Armory basements as well as monitoring wells 83-7, 82-3, HL90-1 and 82-2. Values over 100% of the lower explosive limit (LEL) were obtained using a gas-Tech Tank Techtor in wells 83-7 and 82-3. The LEL for methane is 5% or 50,000 parts per million (ppm). It is important to note that Tank Techtor is calibrated to hexane and that methane values over 42% LEL will register a 100% LEL reading on the instrument.

To verify the results of the findings, well 82-3 was retested with the Tank Techtor at the same time as a grab air sample was obtained. At this time the Tank Techtor gave a reading of about 60% LEL. Adjusted for methane this equals (60% x .42 = 25.2% or

12600 ppm). On a no methane response mode the instrument showed a 0% LEL reading indicating that the gas was essentially all methane. The air sample was sent to a laboratory for a routine natural gas analysis. This analysis indicated that methane was the only organic gas present. The concentration of methane was 3000 ppm, a discrepancy of about four times. This indicates that portable field analyzers may be quite inaccurate and that results should be correlated to laboratory samples. Table 6.3 shows the results of methane monitoring with the organic vapor analyzer. These results indicate that the areal extent of methane gas is limited to the buried refuse areas and that the concentrations of methane at selected sites is well below the lower explosive limit.

should sample quarterly

Post-closure monitoring at the Helena Landfill will encompass the entire area as well as peripheral areas. Table 6.4 shows wells which will be monitored on a semiannual basis and the method of analysis. Monitoring will consist of testing a group of wells, that have previously high methane concentrations, with an organic vapor analyzer such as a Foxboro OVA 128GC or a Gastech Tank Techtor. In addition to this, an air sample will be obtained at the well with the highest detected methane concentration. This sample will be analyzed at a laboratory and will serve to establish a reliable correlation between the organic vapor analyzing instrument and actual values. Wells peripheral to landfill that have not previously shown detectable concentrations of methane will be analyzed with colorometric tubes. These tubes can detect the presence of methane at low concentrations and have proven to be a reliable methane detection instrument. The

TABLE 6.3 METHANE MONITORING SITES

HL-7	- Organic vapor instrument
HL90-2	- Organic vapor instrument
HL90-1	- Colorimetric tube
I-5	- Colorimetric tube
HL90-3	- Colorimetric tube
82-3	- Organic vapor instrument
EPA-4	- Organic vapor instrument
83-7	- Organic vapor instrument
82-2	- Organic vapor instrument
82-4	- Organic vapor instrument
Scale House	- Colorimetric tube
Elk River	- Colorimetric tube
EPA-2	- Organic vapor instrument
EPA-1	- Organic vapor instrument
HL-1	- Colorimetric tube
YMCA	- Colorimetric tube
Armory	- Colorimetric tube

Note: See Exhibit 1 for site locations.

TABLE 6.4: Concentrations of methane in parts per million from selected locations.

LOCATION	DATE	ORGANIC VAPORS DETECTED			SITE CONDITIONS
		BACKGROUND	TOTAL	METHANE	
MPC Office	07-Jul-91	6.4	6.4	6.4	Office Basement
YMCA	07-Jul-91	0	0	0	Fire Department Reading
Armory	07-Jul-91	0	0	0	Fire Department Reading
82-3	07-Jul-91	6.3	12	11	next to landfill shop has had prior high values
HL90-3	07-Jul-91	6.4	6.4	6.5	near pavement and Railroad sparse vegetation
HL90-1	07-Jul-91	5.7	5.7	5.7	near compacted dirt road sparse vegetation
HL90-2	07-Jul-91	5.4	5.4	5.4	200' from pond good vegetative cover
82-2	07-Jul-91	5.8	5.8	6	in railroad cut sparse vegetation
EPA-1	07-Jul-91	6	22	16	10' from pavement good vegetative cover
83-7	07-Jul-91	5.4	50	50	near railroad tracks good vegetative cover
82-4	07-Jul-91	6.4	300	300	center of landfill good vegetative cover near well
EPA-4	07-Jul-91	6.9	7.1	7.3	near unpaved road sparse vegetation
HLP91-1	07-Jul-91	4.4	4.6	4.6	15' from drain channel sparse vegetation
I-2	07-Jul-91	NO ACCESS	NO ACCESS	NO ACCESS	golf course irrigation well being pumped
I-4	07-Jul-91	NO ACCESS	NO ACCESS	NO ACCESS	in locked well house
Elk River	07-Jul-91	5.6	5.6	5.6	in office/shop building
Landfill Office	07-Jul-91	6.8	6.8	6.8	in scalehouse
HL-1	07-Jul-91	6	5.9	6	on cut slope below paved road 8' from compacted dirt road
HL-7	07-Jul-91	4.8	4.8	4.8	sparse vegetation
I-5	07-Jul-91	6.6	6.6	6.6	near compacted dirt parking lot and concrete sidewalk
I-6	07-Jul-91	NO ACCESS	NO ACCESS	NO ACCESS	sparse vegetation
EPA-2	07-Jul-91	5.6	5.1	5.1	near paved parking lot good vegetative cover
EPA-3	07-Jul-91	NO ACCESS	NO ACCESS	NO ACCESS	near paved parking lot and paved street
Calibration Standard	08-Jul-91	6.5	108	100	100 ppm methane calibration standard

monitoring with colorimetric tubes will be performed to assure that the area in which methane gas is present has not enlarged.

Due to the potential for methane accumulation in any part of the landfill, no excavation or construction shall be allowed in or adjacent to the landfill without proper methane surveys being performed. Federal safety regulations, (OSHA), outline the proper procedures to follow in such a case. The City of Helena shall notify all departments that may potentially access the landfill area of these procedures. In Appendix D is a letter sent to all of the utility companies that could be excavating in the landfill area. In addition, this letter was also sent to Carroll College, Elkriver Concrete, and necessary City of Helena personnel.

7.0 FUTURE LAND USE

The City of Helena has designated no specific use for the reclaimed landfill area at this time. A personal communication with Mr. Randy Lilje of the City of Helena Parks Department in June 1991, indicated that the land use currently being considered (but not committed to) would be a grassed park area similar to that of Centennial Park. This use would dictate that irrigation of the grass would need to be implemented and a soil moisture and water balance control system similar to that at Centennial Park would need to be implemented. Final land use will be determined by the City after all possible options have been evaluated.

8.0 REFERENCES

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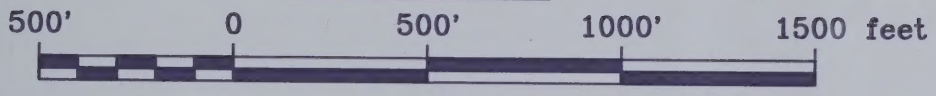
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Scale



Project:

City of Helena Landfill

Sheet Title:

Domestic and Monitoring Well Locations and Potentiometric Contour Map

Drawn: GJF
Checked: SD
Approved: RH
Date: 8/9/91
Rev. #:

Hydrometrics, Inc.
Consulting Scientists and Engineers
2727 Airport Road
Helena, Montana 59601
(406) 443-4150

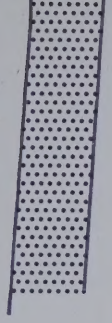
EXHIBIT 1

HLF18-91


SILSBEE RD
REED RD
WILLOW RD
DUNBAR RD
CUSTER AVENUE
VALLEY DR
BRADY ST
OVAL J ST
LARSON ST
HARTLEY
KEVIN
MICHAEL
MEADOW DR
GREENWOOD DR
ANDERSSON BLVD
CAPITAL
OAKWOOD LN
BILL ROBERTS MUNICIPAL GOLF COURSE
BATCH FIELDS
WAREHOUSE
DAWSON ST
WAUKESHA AVE
FROST AVE
HOLMES AVE
LESLIE AVE
WILDER AVE
EUCLID AVE
BENTON AVE
MONTANA RAIL LINK
CARROLL COLLEGE
RALPH ST
HENRY ST
PARK AVE
CENTENNIAL PARK
YMCA
3830
3840
3850
3860
3870
3880
HL90-1
8.9
HL90-2
2.9
HL90-3
<1.0*
82-4
82-3
EPA4
HL-1
HL-2
HL-5
HL-7
83-5
83-6
ND
83-7

ewer Line

12" Sewer Line



Project:

City of Helena Landfill

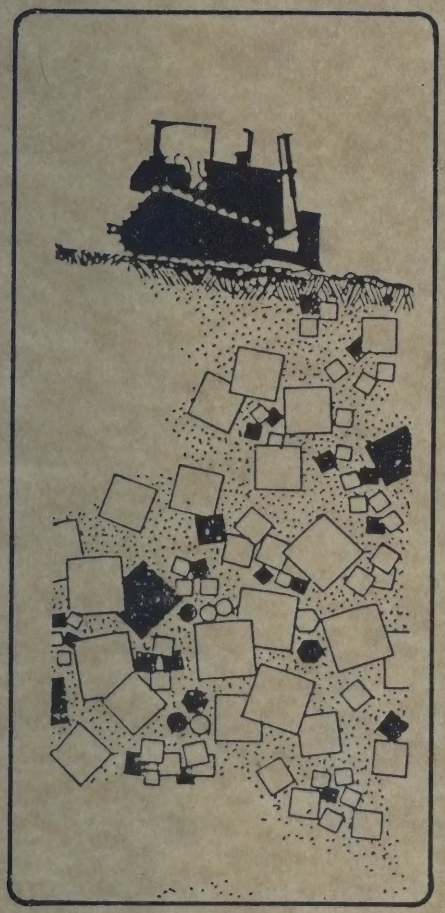
Sheet Title:

Closure Plan – Final Grading and Drainage

Drawn: SD
Checked: SD
Approved: MKB
Date: 7/7/91
Rev. #:

Hydrometrics, Inc.
Consulting Scientists and Engineers
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Helena, Montana 59601
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Exhibit No.
3

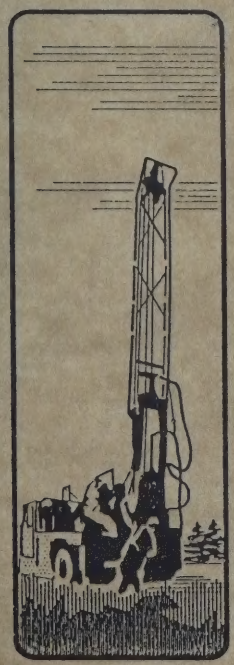


Revised Helena Landfill Closure Plan

Submitted To:
Montana Department of Health and Environmental Sciences

Submitted By:
City of Helena
Helena, Montana

City of Helena



Prepared By:
Hydrometrics, Inc.
Consulting Scientists and Engineers
Helena, Montana 59601

March 1993



NORTH

Legend

- HL-2 ■ Piezometer
- 83-5 ○ Abandonded Monitoring Well
- 83-6 ● Monitoring Well
- I-6 ▲ Irrigation Well
- 80 ⊙ Domestic Well
- Infiltration Gallery
- 3950 — Potentiometric Contour (Dashed Where Inferred)
- Approx. Location Of Storm Drain

Scale

500' 0 500' 1000' 1500 feet

Project:
City of Helena Landfill

Sheet Title:
Domestic and Monitoring Well Locations and Potentiometric Contour Map

Drawn: GJF
Checked: SD
Approved: RH
Date: 8/9/91
Rev. #:

Hydrometrics, Inc.
Consulting Scientists and Engineers
2727 Airport Road
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EXHIBIT 1

HLF18-91



Revised Helena Landfill Closure Plan

Submitted To:

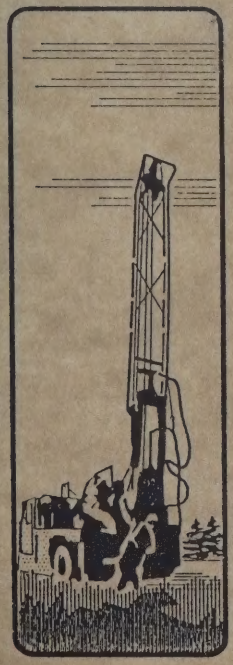
Montana Department of Health and Environmental Sciences

Submitted By:

City of Helena

Helena, Montana

City of Helena



Prepared By:

Hydrometrics, Inc.
Consulting Scientists and Engineers
Helena, Montana 59601

March 1993


Lewis & Clark
County Fairgrounds
SILSBEE RD
RICKD RD
WILLOW RD
DUNBAR RD
CUSTER AVENUE
BRADY ST
OVAL 1 ST
LARSON ST
HARTLEY
MEADOW DR
OAKWOOD LN
ANDERSON BLVD
WAREHOUSE
HUDSON ST
LOCUST AVE
ROBBINS AVE
LESLIE AVE
WILDER AVE
EUCLID AVE
BENTON AVE
BILL ROBERTS
MUNICIPAL GOLF
COURSE
BATCH
FIELDS
MONTANA RAIL LINK
CARROLL
COLLEGE
CENTENNIAL
PARK
YMCA
RALPH ST
HENRY ST
PARK AVE
FRONT ST
10TH ST
14TH ST
3830
3840
3850
3860
3870
3880
3890
HL90-1
6.9
HL90-3
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2.9
HL90-2
82-4
HL-7
HL-6
82-3
EPA4
HL-5
83-7
EPA2
HL-2
HL-1
83-5
83-6
ND
5
ND
2.4
3.2
2.1
2.4



Legend

- HL-2 ■ Piezometer
- 83-5 ○ Abandonded Monitoring Well
- 83-6 ● Monitoring Well
- I-6 ▲ Irrigation Well
- 80 ⊙ Domestic Well
- Infiltration Gallery
- 3950 — Potentiometric Contour (Dashed Where Inferred)
- 2.9 Concentration of Dichlorofluoromethane Parts Per Billion (ppb) (Isoconcentration Line Dashed Where Inferred)
- <1.0* – 4.0 Dichlorodifluoromethane
- 4.0 – 10.0 Dichlorodifluoromethane
- >10 Dichlorodifluoromethane
- <1.0* Present But Less Than The Laboratory Quantifiable Limit
- ND Not Detected
- Approx. Location Of Storm Drain

Scale

500' 0 500' 1000' 1500 feet

Project:

City of Helena Landfill

Sheet Title:

Estimated Extent Of Dichlorodifluoromethane In Groundwater – Spring 1991

Drawn: JHD
Checked: SKD
Approved: RH
Date: 8/19/91
Rev: 9/9/91

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EXHIBIT 2

HLF11-91



REVISIONS NO.	BY	DATE	DESCRIPTION
10			
9			
8			
7			
6			
5			
4			
3			
2	GJF	4/8/93	Add Contours
1	GJF	4/6/93	Extend Map to Lyndale Avenue





Scale

150' 0 150' 300' 450 feet

NOTE: This Plan Shows Final Grading at Time of Landfill Closure. For Final Post-Construction Grading and Construction Details for Proposed Transfer Station See Damschen and Associates Transfer Station Details. (Datum on Damschen Plan is 4.75' Lower than Datum on this Plan)

Legend

- Proposed Finish Grade Contours
- Existing Contours
- General Surface Water Flow Direction
- Storm Sewer Line
- Sanitary Sewer Line
- Existing Building
- Proposed Building
- Railroad Tracks
- Existing Concrete Culvert
- Proposed CMP Culvert
- Landfill Cell Extent (PIT 3)

Project:

City Of Helena

Sheet Title:

Final Grading Plan

Drawn: GJF
Checked: SD
Approved: MRW
Date: 4/1/93
Rev. #: 2

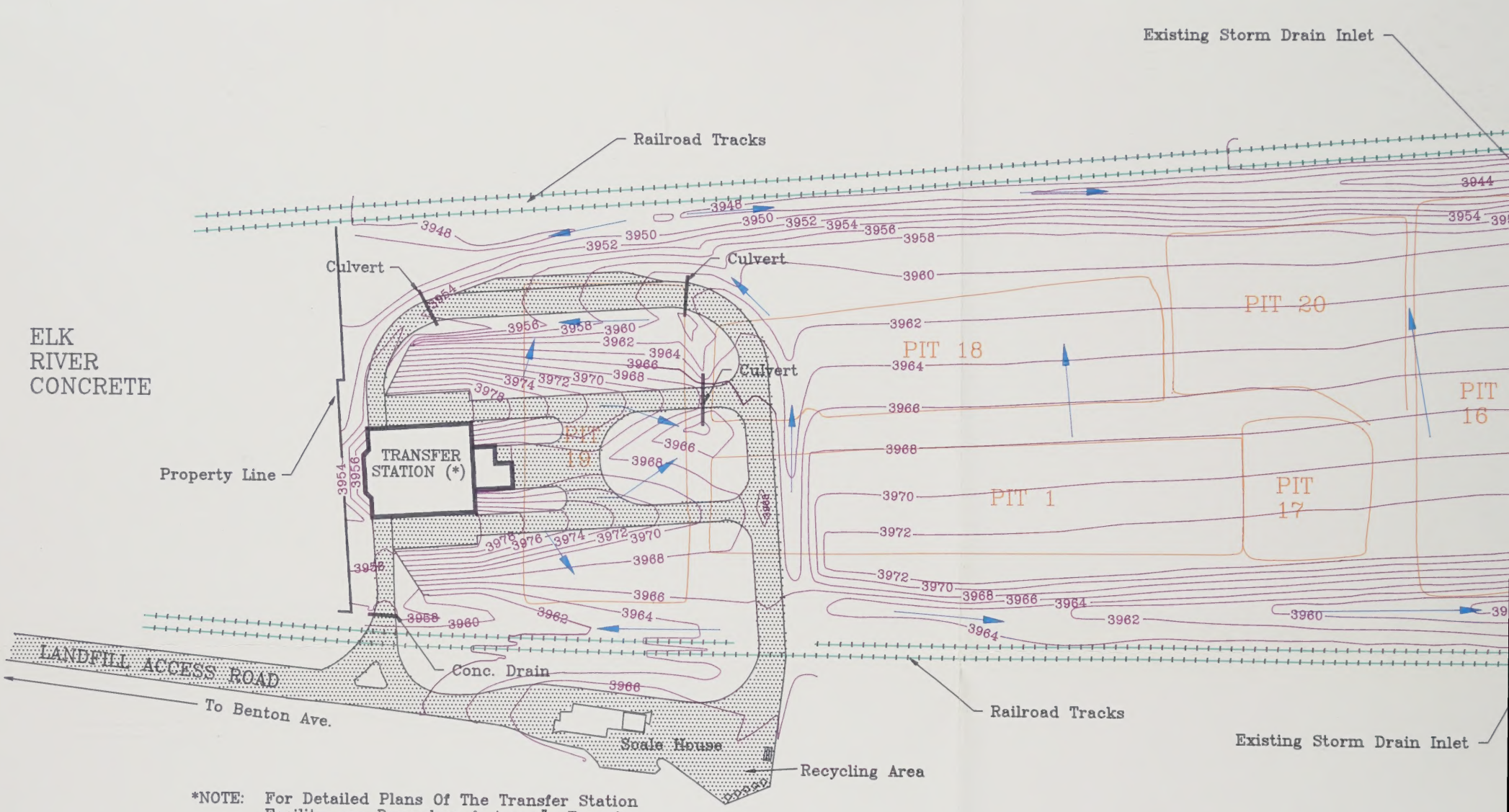
Hydrometrics, Inc.
Consulting Scientists and Engineers
2727 Airport Road
Helena, Montana 59601
(406) 443-4150

EXHIBIT 3

HLF2793F

CITY OF HELENA LANDFIL
FINAL GRADING PLAN

NORTH



*NOTE: For Detailed Plans Of The Transfer Station Facility, see Damschen & Assoc."s Transfer Station Final Contour & Landscaping Plan.

SCALE
1 inch = 100 feet

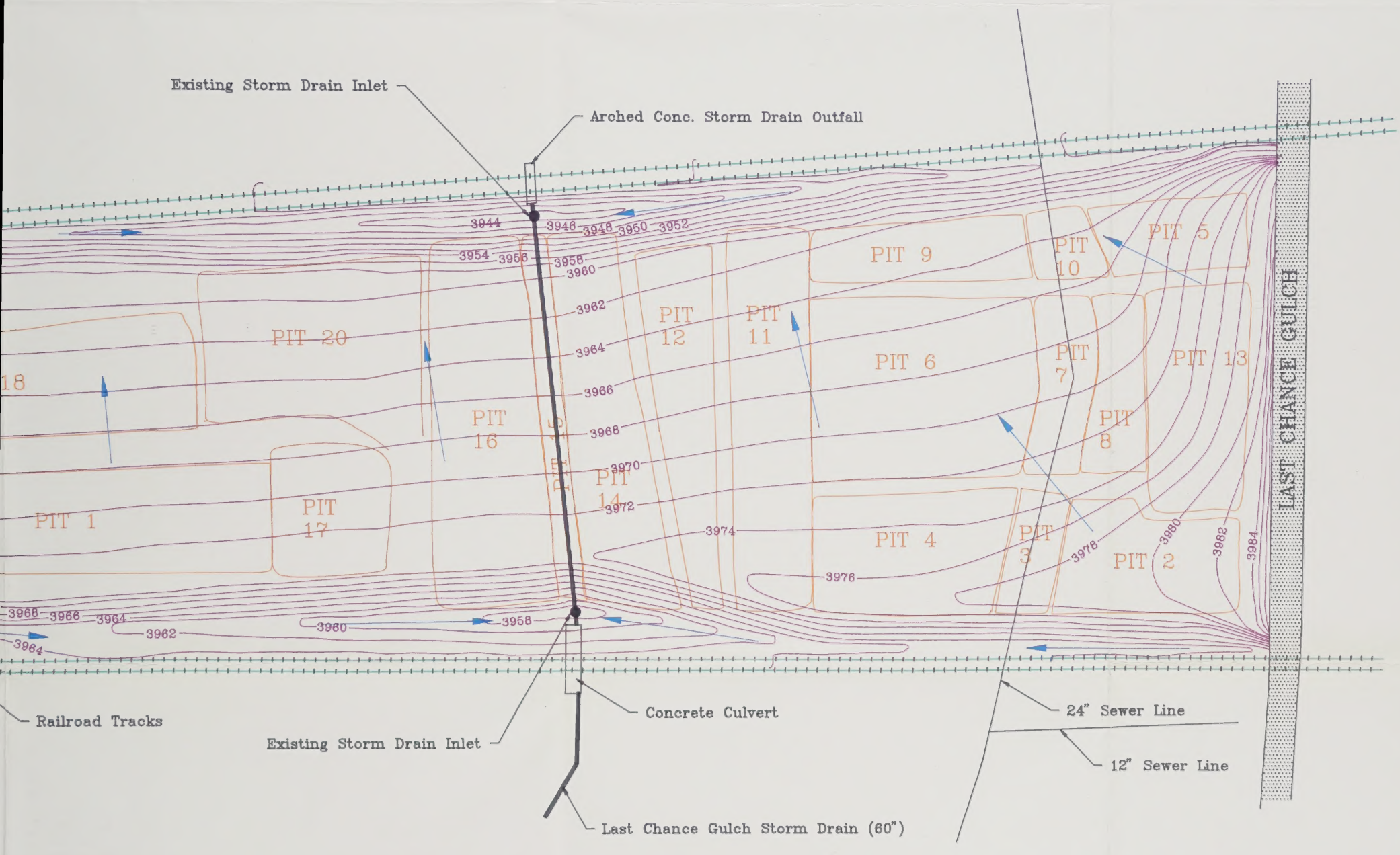
LEGEND

3960 — Final Grade Contour and Elevation

PIT 17 — Outline and Number of Landfill Pit

Direction of Runoff Flow

OF HELENA LANDFILL
AL GRADING PLAN



SCALE
1 inch = 100 feet

REVISIONS NO.	BY	DATE	DESCRIPTION
10			
9			
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Project:
City of Helena Landfill

Sheet Title:
Closure Plan – Final Grading and Drainage

Drawn: SD
Checked: SD
Approved: MKB
Date: 7/7/91
Rev. #:

Hydrometrics, Inc.
Consulting Scientists and Engineers
2727 Airport Road
Helena, Montana 59601
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Exhibit No.
3

REVISED
HELENA LANDFILL CLOSURE PLAN

Submitted to:

Montana Department of Health and
Environmental Sciences
Solid and Hazardous Waste Bureau
Cogswell Building
Helena, MT 59620

By:

City of Helena
316 North Park
Helena, MT 59620

Prepared by:

Hydrometrics, Inc.
2727 Airport Road
Helena, MT 59601

September 1991
REVISED March 1993

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EXHIBIT 1. DOMESTIC AND MONITORING WELL LOCATIONS AND POTENTIOMETRIC CONTOUR MAP

EXHIBIT 2. EXTENT OF DICHLORODIFLUOROMETHANE FOR SPRING 1992 SAMPLING EVENT

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APPENDIX B. STORM DRAIN OUTFALL FLOW MEASUREMENTS

APPENDIX C. COVER SOIL TESTING DATA

APPENDIX D. TOPSOIL DATA

APPENDIX E. METHANE INFORMATION

HELENA LANDFILL CLOSURE PLAN
REVISED 3-93

1.0 INTRODUCTION

This closure plan for the City of Helena Landfill is designed to meet all requirements set forth by the State of Montana in the Administrative Rules of Montana, Title 16, Chapter 14 - Solid Waste Management, Sub-chapter 5 - Refuse Disposal; Sub-chapter 7 - Proposed Groundwater Monitoring Rules for Landfills in Montana; and Subtitle D closure requirements as set forth under 40 CFR Parts 257 and 258. The Montana regulations are outlined in the Montana Department of Health and Environmental Sciences (MDHES), Solid and Hazardous Waste Bureau's document of April 3, 1991, entitled "Class II Landfill Closure Requirements and Recommendations".

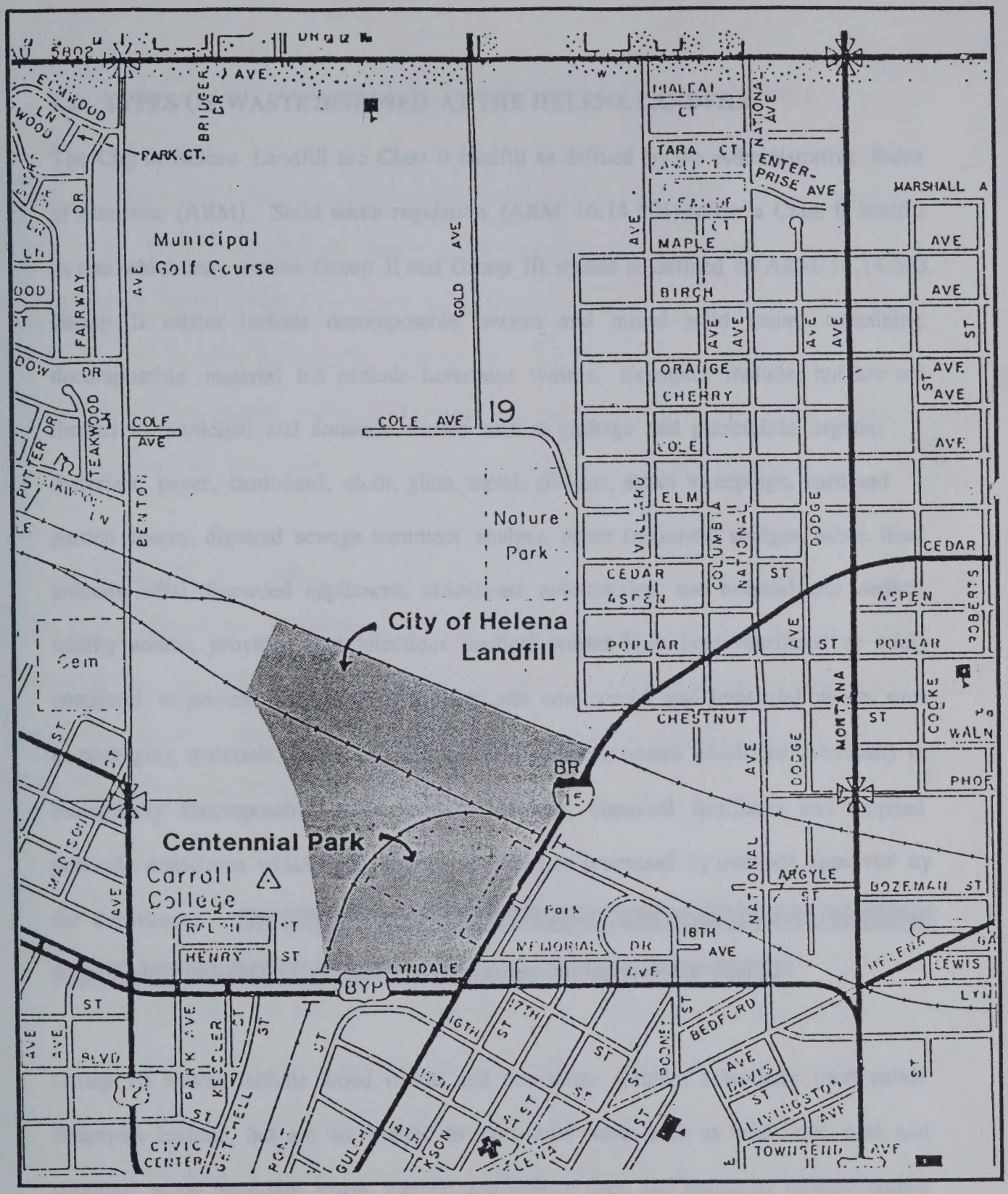
The final closure date of the City of Helena Landfill is dependant on opening of the new Lewis and Clark County "Site E" Landfill (which is in the permitting process at this time), or arranging a different interim waste disposal alternative . Due to the uncertainty of the opening date of the new landfill, the final closure date for the City of Helena Landfill cannot be given, however, the City is committed to closing the landfill before October 9, 1993. The City of Helena plans to operate under an interim closure for this period and will coordinate all final closure activities with the MDHES at the appropriate time.

1.1 OPERATING HISTORY OF HELENA LANDFILL

The City of Helena Landfill is located east of Carroll College, west of Memorial Park, and North of Lyndale Avenue (Figure 1.1). The landfill encompasses about 37 acres of active and inactive landfill areas. The landfill was activated in the late 1800s when open burning was the primary disposal method. The present landfill operations were begun in 1970 when sanitary landfill regulations were promulgated and open burning ceased (EPA, 1989).

The Helena Landfill has accepted an average of 75 to 80 tons of domestic refuse per day since the early 1970s (Personal communication, Willie Miller - City of Helena Landfill Supervisor, July, 1990). Several filled areas have been deactivated and reclaimed over the history of the Helena Landfill.

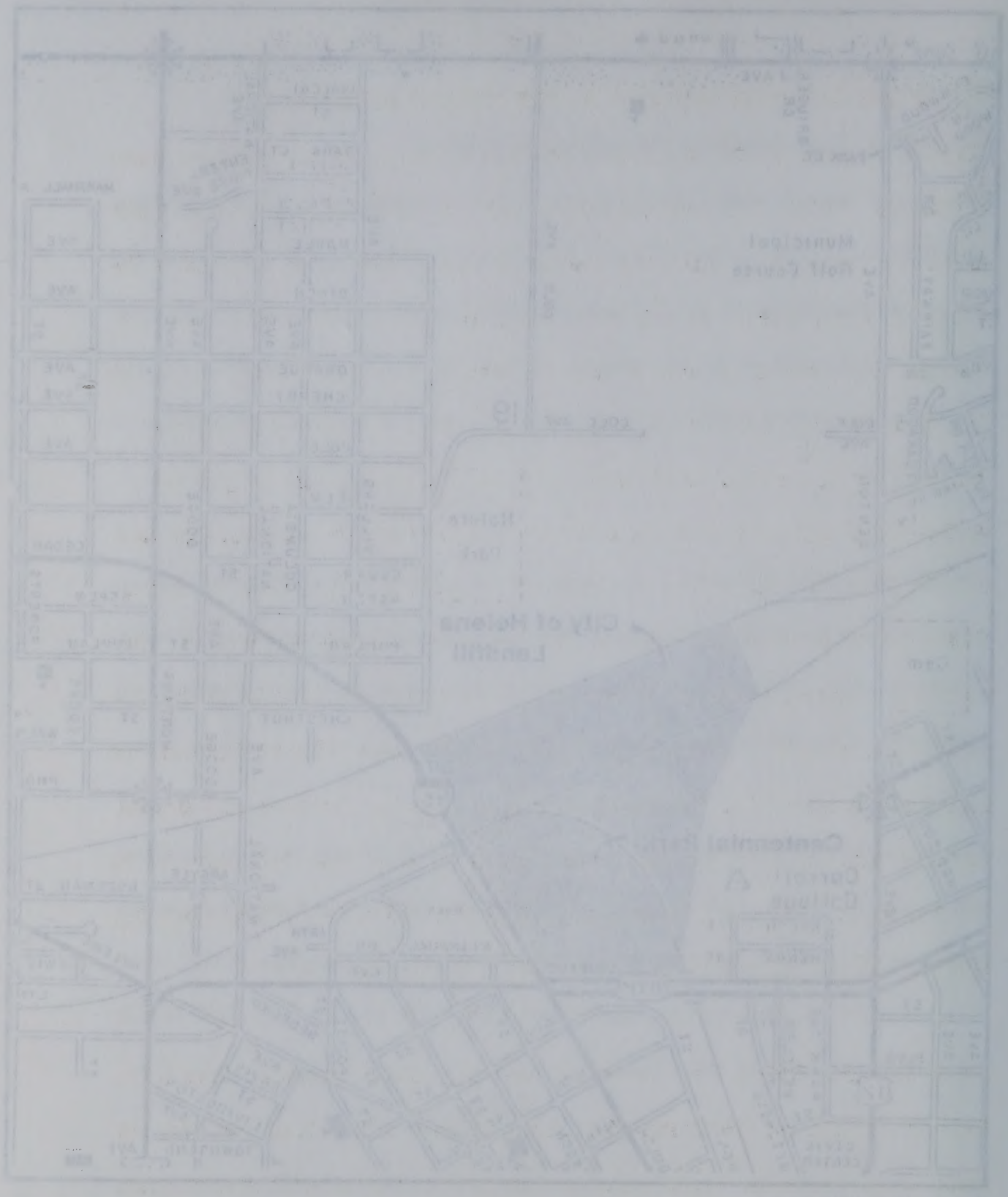
Refuse was initially placed south of the railroad tracks and this area has been reclaimed and is now Centennial Park (Figure 1.1). Centennial Park is a grassed area used for recreational activities such as soccer, baseball, and jogging. The present active landfill area is between two east-west running railroad tracks north of Centennial Park (Figure 1.1), and has been active since 1982.



Scale: 1" = 1000 feet

NORTH

Figure 1.1: City of Helena Landfill Location Map



1.2 TYPES OF WASTE DISPOSED AT THE HELENA LANDFILL

The City of Helena Landfill is a Class II landfill as defined by the Administrative Rules of Montana (ARM). Solid waste regulation (ARM 16.14.504) define a Class II landfill as one which may receive Group II and Group III wastes as defined by ARM 16.14.503. Group II wastes include decomposable wastes and mixed solid wastes containing decomposable material but exclude hazardous wastes. Examples include, but are not limited to municipal and domestic wastes such as garbage and putrescible organic materials, paper, cardboard, cloth, glass, metal, plastics, street sweepings, yard and garden wastes, digested sewage treatment sludges, water treatment sludges, ashes, dead animals, offal, discarded appliances, abandoned automobiles, and hospital and medical facility wastes, provided that infectious medical wastes have been sterilized or safely contained to prevent the danger of disease; and commercial and industrial wastes such as packaging materials, liquid or solid industrial process wastes which are chemically or biologically decomposable, crop residues, manure, chemical fertilizers and emptied pesticide containers which have been triple rinsed or processed by methods approved by the department. The City of Helena Landfill also contains some asbestos containing wastes which was buried along with other refuse throughout the landfill.

Group III wastes include wood wastes and non-water soluble, essentially inert solids. Examples include, but are not limited to inert solid waste such as brick, dirt, rock and concrete; wood materials, brush, lumber, and vehicle tires; and industrial mineral wastes which are essentially inert and non-water soluble, and do not contain hazardous waste constituents.

2.0 HYDROGEOLOGY OF THE HELENA LANDFILL AREA

Several studies evaluating soils, hydrogeology and water quality in the Helena Landfill area have been conducted in recent years. These studies include EPA Field Investigation Team studies in 1987 and 1989, Hydrometrics, Inc.'s studies in 1982, 1983 and 1990, and F and M Consultants' study in 1982. The United States Geological Survey has also conducted several studies of the geology and hydrogeology of the Helena Valley. All of these studies have been considered in the preparation of this closure plan.

2.1 GEOLOGIC SETTING

The City of Helena Landfill is located at the edge of the Helena Valley near the base of Mount Helena. The hills and mountains peripheral to the Helena Valley are folded and faulted igneous, sedimentary and metamorphic rocks that range in geological age from Precambrian to Tertiary (Wilke and Coffin, 1973).

The Helena Landfill is at the mouth of Last Chance Gulch at the southern edge of the Helena Valley. The gulch in this area is underlain with alluvial deposits of Quaternary and Tertiary geological age that are in geological contact with igneous bedrock at Carroll College and limestone bedrock beneath the U.S. National Guard Armory and YMCA buildings adjacent to Last Chance Gulch. The alluvial stream and fan deposits are indistinguishable and are composed of layers, lenses and mixtures of unconsolidated clay, silt, sand, gravel and cobbles (Coffin, 1971). The alluvial material is variable in lithology with limestone and dolomite clasts from the Precambrian Helena Dolomite Formation,

and clasts of intrusive igneous rocks of Cretaceous age being common. The former has been uplifted and exposed to the south of Helena, and the latter is present as an elevated bedrock hill in the Carroll College area. Alluvial fan and stream deposits were probably deposited by an interconnecting network of paleochannels which resulted in the heterogeneous alluvium at the mouth of Last Chance Gulch.

In the vicinity of the Bill Roberts Golf Course (just north of the landfill), the Quaternary alluvium has been extensively placer mined for gold. The dredge tailings vary in thickness from 25 to 50 feet and are underlain by unconsolidated to semi-consolidated sediments of Tertiary age and by alluvium too deep to dredge. The Tertiary sediments vary in thickness from many hundreds of feet in the central Helena Valley to relatively thin deposits along the valley's edges (Hydrometrics, 1982). These Tertiary sediments are underlain by the Precambrian Helena Dolomite Formation and possibly the Empire and Spokane Formations. The Helena Dolomite is a siliceous dolomite with subordinate limestone. Wells located just north of Carroll College are completed in this formation and yield only small quantities of water. An irrigation well drilled in the Bill Roberts Golf Course encountered a green argillite at a depth of about 200 feet. This argillite is likely a Precambrian age rock of the Empire and Spokane Formation, or the Marsh Formation. The bedrock mound that forms the hill on which Carroll College sits is an igneous intrusive (diorite porphyry) which intruded upward through the older formations.

2.2 HYDROGEOLOGY

Groundwater in the landfill area occurs both in the alluvium and the underlying bedrock. North of the landfill, groundwater occurs in dredge piles left by historic mining at the mouth of Last Chance Gulch, and in the semi-consolidated Tertiary sediments. These sediments are heterogenous in nature.

Groundwater flow in the study area is generally to the north and northwest with an average gradient of about 0.05 ft/ft. Exhibit 1 shows a potentiometric surface map of the alluvial system during the Spring 1992 monitoring event (Fall 1992 data has been collected and data as well as an annual report will be submitted to MDHES by the City/County water quality district). Hydrometrics (1982) estimated the groundwater flow rate through the alluvium underlying the landfill to be approximately 28 gallons per minute. This flow rate is based on a hydraulic conductivity of 100 gpd/ft^2 (F and M Consultants, 1982), an average saturated thickness of 20 feet, and an average valley width of 400 feet. Assuming a porosity of 25% for the alluvium, the average groundwater velocity in the vicinity of the landfill is estimated to be 2.68 ft/day. Based on additional data obtained by Hydrometrics, Inc. in 1990, these earlier velocity and flow estimates could be as much as an order of magnitude low. Table 2.1 shows hydrogeological characteristics of selected sites in the landfill area. At these sites, transmissivity (the ability to transmit water) of the alluvium ranges from 1,680 gpd/ft to 33,000 gpd/ft (Hydrometrics, 1990). This broad range is due to the heterogeneous nature of the alluvium in the landfill area.

Table 2.1: Hydrogeologic Characteristics Of Selected Sites

WELL OR PIT	GEOLOGIC MATERIAL	TRANSMISSIVITY	HYDRAULIC CONDUCTIVITY
GOLF COURSE TW-	Poorly sorted alluvium - sand, gravel, cobbles and minor clay	7920 gpd/ft	2x10-3 cm/sec
GOLF COURSE TW-	Semi-consolidated bedrock "Caliche"	1680 gpd/ft	7x10-4 cm/sec
South Pit *	Disturbed stream channel	11,000 gpd/ft	
North Pit *	Coarse sandy gravel	33,000 gpd/ft	

* From Robert Peccia and Associates (1982) Study For Bill Roberts Municipal Golf Course

MAP LOCATION	APPROX. SPECIFIC CAPACITY	MAP LOCATION	APPROX. SPECIFIC CAPACITY
1	0.36	36	1
5	1.25	37	0.3
6	0.41	38	0.36
7	0.81	39	1
13	0.31	40	1
15	0.24	41	0.53
16	0.32	42	0.66
19	0.5	43	0.3
20	0.43	44	0.62
21	4.28	54	0.6
24	0.18	56	3.7
26	0.008	62	0.42
27	0.01	65	0.36
28	0.07	67	0.29
29	0.07	73	0.14
30	0.47	75	1
31	0.15	78	0.67
35	0.56		

NOTE: Specific Capacities were calculated form short term pumping test data and are only approximations.

Fodder

The unconsolidated alluvium varies in texture from a silty or clayey sand to medium or coarse-grained sand containing gravel and cobbles. Textural variations are likely due to the changing environment during deposition of the alluvium with the more coarse-grained materials associated with high energy outflows from Last Chance Gulch into the Ten Mile Creek drainage. As the groundwater moves out of the landfill area, to the north, the groundwater gradient flattens indicating more transmissive materials in this part of the valley.

Wells completed in bedrock southwest of the landfill exhibit much lower specific capacities (amount of water yield per foot of drawdown) than wells completed in the alluvium. Alluvial wells in the area are typically 60 to 100 feet deep, while bedrock wells are typically deeper than 250 feet. Water wells in and around the landfill area have been inventoried (Table 2.2) and are shown on Exhibit 1.

Any bedrock wells on list?

Semi-consolidated, alluvial deposits of Tertiary age were encountered north and west of the landfill during drilling of golf course irrigation well I-3 and monitoring well HL90-1 (Exhibit 1). These semi-consolidated deposits are less transmissive than the overlying, unconsolidated alluvium and are composed of calcite cemented sands and gravels sometimes referred to as "caliche".

The thickness of the alluvium increases from a few feet near Lyndale Avenue (see Exhibit 1) to about 200 feet at golf course well I-3. Figure 2.1 is a hydrogeological cross-section based on monitoring well data from the northern landfill boundary area. A

TABLE 2.2: HELENA LANDFILL AREA WELL INVENTORY

NUMBER	ADDRESS	OWNER	DEPTH	PERFORATED ZONE
1	230 Meadow Dr.	G. Amestoy	100	---
2	233 Meadow Dr.	C. Colarchic	---	---
3	227 Greenwood	A. Holzwarth	---	44-64
4	5 Deborah Ct.	T. Johnson	100	---
5	350 Custer Ave.	S. Colvin	80	60-80
6	3119 Bridger	J. Garman	100	70-100
7	454 Vigilante	R. Stenquist	51	---
8	3107 Vigilante	C. Knutson	101	80-100
9	3130 Vigilante	C. Tielking	61	---
10	448 Russell	L. Peterman	---	---
11	472 Russell	J. Zimmerman	---	---
12	448 Paxon	M. Parriman	68	60-68
13	102 Oakwood	E. Johnson	118	78-118
14	104 Oakwood	K. Rogers	115	70-110
15	106 Oakwood	E. Darfler	140	90-140
16	3 Parr Court	C. Tilzey	65	54-64
17	105 Wedgewood	F. Robinson	---	---
18	108 Wedgewood	B. Hartman	---	---
19	119 Wedgewood	D. Clark	115	90-115
20	3 Terry Court	H. Peterson	120	80-120
21	146 Briarwood	R. Karp	52	12-52
22	154 Briarwood	R. Burger	---	---
23	114 Ridgewood	T. Berry	75	55-75
24	1130 Waukesha	E. Johnson	180	100-180
25	1703 Waukesha	M. Carmichael	---	---
26	932 Peosta	G. Daly	300	---
27	1110 Peosta	S. McCann	360	---
28	1314 Peosta	M. Johnson	278	170-270
29	1331 Peosta	R. Guse	300	120-290
30	1611 Peosta	R. Brohman	135	---
31	1430 Brady	D. Gardner	101	75-95
32	1815 Brady	W. Routzahn	220	140-220
33	1317 Hudson	C. Engstedt	---	---
34	1325 Hudson	K. Erickson	118	78-118
35	1427 Broadwater Cir.	Broadwater Vill.	215	95-215
36	3203 Cooney	Kalamity Bros.	45	38-45

--- Denotes information not found. Inventory is based on DNRC records and field investigation.

TABLE 2.2: HELENA LANDFILL AREA WELL INVENTORY

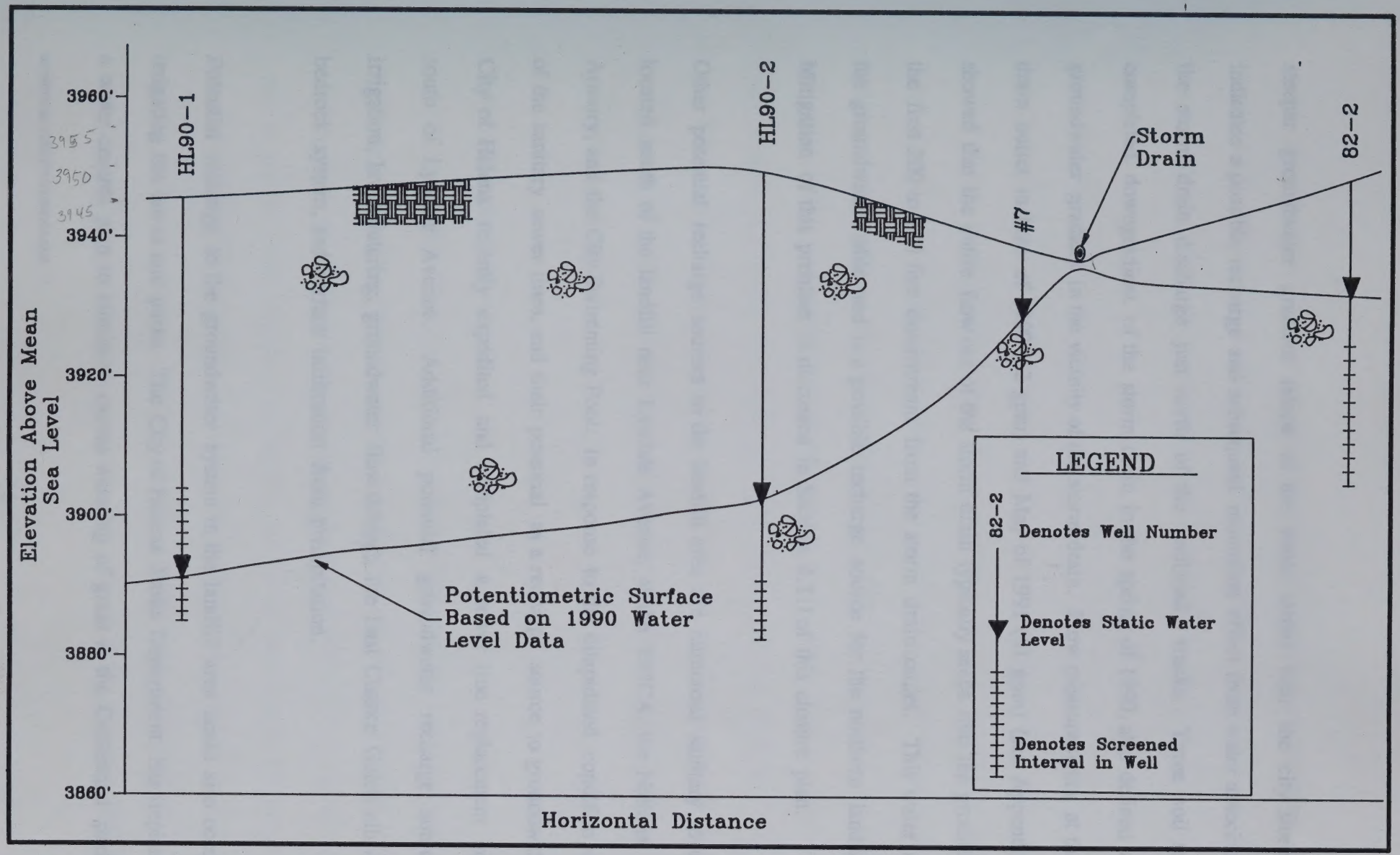
37	235 Anderson Blvd.	G. South	100	40-100
38	227 Anderson Blvd.	T. Tillo	100	40-100
39	239 Anderson Blvd.	W. Kotan	82	58-82
40	2509 Teakwood	E. Hartman	70	50-70
41	124 Meadow	Strasko	73	53-73
42	112 Meadow	W. Hill	72	52-72
43	246 Brady	Frisch	80	40-80
44	1023 Peosta	Cumley	65	55-65
45	94 Oakwood	Hanson	116	---
46	320 Custer	Colvin	---	---
47	328 Custer	Robinson	---	---
48	308 Custer	C.A. Barbeau	79	---
49	304 Custer	---	---	---
50	226 Custer	---	---	---
51	220 Custer	E. Hartze	64	---
52	Custer & Grn. Meadow	---	---	---
53	121 Dunbar	G. Kercher	---	---
54	122 Dunbar	S. Hitchcock	67	57-67
55	114 Dunbar	---	---	---
56	112 Dunbar	G. Francis	54	---
57	108 Dunbar	Bacon	---	---
58	106 Dunbar	---	---	---
59	100,102 Dunbar	Stolp	---	---
60	No Address - Trailers	---	---	---
61	78 Dunbar	J. Hayes	72	---
62	76 Dunbar	J. Bridges	80	60-80
63	110 Willow	G. Milairn	---	---
64	121 Willow	B. Bonogofsky	82	58-82
65	110 Willow	Pool	85	---
66	108 Willow	---	---	---
67	105 Willow	O'Neal	100	60-100
68	104 Willow	J. Creach	80-100	---
69	19 Willow	Horsecienda Hotel	---	---
70	11 Willow	Gardner	55	---
71	3204 Mitchell	Chamberlain	---	---
72	3208 Mitchell	Hall	---	---
73	3212 Mitchell	Tovey	72	52-72
74	3216 Mitchell	Allison	---	---
75	104 Reed	J. Creach	70	22-70

--- Denotes information not found. Inventory is based on DNRC records and field investigation.

TABLE 2.2: HELENA LANDFILL AREA WELL INVENTORY

76	Trailer Court on Reed	---	---	---
77	115 Reed	---	---	---
78	120 Reed	W. Cole	50	42-50
79	SW Corner Grn Mdw/Reed	---	---	---
80	3280 Green Meadow	Trails West	---	---
81	3300 Green Meadow	G. M. Market	---	---
82	County Fairgrounds	Fairgrounds	---	---
83	610 W. Custer	AAA Car Wash	---	---
84	500 Cole Ave.	---	---	---
85	210 Harwood	Ralston	75	15-75
86	15 Reed	C. Bryant	72	---
HL-90-1	---	City of Helena	60	40-60
HL-90-2	---	City of Helena	68	60-68
HL-90-3	---	City of Helena	79	59-79
83-6	---	City of Helena	25	19-23
83-7	---	City of Helena	40	32-37
82-1	---	City of Helena	40	14-34
82-2	---	City of Helena	43	23-43
82-3	---	City of Helena	83	43-83
82-4	---	City of Helena	79	44-74
HL-1	---	EPA	---	---
HL-2	---	EPA	---	---
HL-5	---	EPA	---	---
HL-6	---	EPA	---	---
HL-7	---	EPA	---	---
EPA1	---	EPA	54.5	39.5-54.5
EPA2	---	EPA	55.1	40.1-55.1
EPA3	---	EPA	95	85-95
EPA4	---	EPA	76.2	66.2-76.2
I-1	---	Golf Course	146	35-95
I-2	---	Golf Course	---	---
I-3	---	Golf Course	220	71-170 (Zones)
I-4	---	Batch Fields	156	60-156
I-5	---	Carroll College	550	100-550
I-6	---	Carroll College	320	100-320
I-7	---	Golf Course	---	---

--- Denotes information not found. Inventory is based on DNRC records and field investigation.



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Dwg. No:	HLF17-91
Scale:	AS NOTED
Date:	
Rev Date:	4/9/93

Scale: Horizontal 1" = 300'
Vertical 1" = 20'

Figure 2.1: Hydrogeological Cross-Section Through Helena Landfill



steeper groundwater gradient (slope of the water table) near the city storm drain indicates a possible recharge and subsequent mounding effect from water associated with the storm drain discharge just north of the railroad tracks. Three soil test pits, completed downgradient of the storm drain in the spring of 1990, also defined a steep groundwater gradient in the vicinity of the storm drain. Flow measurements at the storm drain outlet in June of 1990 (52 gpm) and May of 1991 (81 gpm) (see Appendix A) showed that the entire flow out of the storm drain typically seeps into the ground within the first 200 to 300 feet downstream from the storm drain outlet. This water mounds the groundwater table and is a possible recharge source for the northern landfill area. Mitigation of this problem is discussed in Section 4.1.1 of this closure plan.

Other potential recharge sources to the landfill area are numerous sanitary sewer lines located south of the landfill near Lyndale Avenue, at the YMCA, the National Guard Armory, and the City Swimming Pool. In response to the dilapidated condition of some of the sanitary sewer lines, and their potential as a recharge source to groundwater, the City of Helena recently expedited and completed a sewer line replacement program south of Lyndale Avenue. Additional potential groundwater recharge sources are irrigation, lawn watering, groundwater flow through the Last Chance Gulch alluvial and bedrock system, and surface infiltration from precipitation.

Potential recharge to the groundwater system in the landfill area could also occur from irrigating the lawns and parks. The City of Helena Parks Department has implemented a water control plan to eliminate excess watering of grass at the Centennial park. The

water balance control plan involves evaporation and transpiration estimates using the Jensen-Haise (1963) ET method, soil moisture monitoring, estimating moisture input from rainfall and irrigation, and water system malfunction checks.

2.3 WATER QUALITY

Many groundwater and surface water quality samples have been obtained in the vicinity of the Helena landfill over the past 13 years. These samples have been analyzed for both organic and inorganic parameters. Most historic data are for inorganic parameters since earlier regulations did not require organic analysis. Appendix A is a compilation of water quality data obtained from the Helena landfill area. The raw laboratory data are included in Appendix B. Additional water quality data are available in EPA's 1987 and 1989 reports. These data are not included because the EPA results showed obvious quality control problems and the results are not considered representative of actual groundwater conditions.

2.3.1 Organic Water Quality

In 1987 and 1989, EPA investigated the Helena landfill site and concluded that site problems were not sufficiently severe to place the site on the National Priority List (NPL). However, EPA analytical results suggested that low levels of organic compounds may be present in the vicinity of the landfill. Additional sampling by Hydrometrics, Inc., in 1989 through Spring 1992 confirmed the presence of very low concentrations of volatile organic compounds (VOCs) beneath and peripheral to the landfill. Table 2.3 summarizes the types, chemical properties and uses of VOCs detected during these

TABLE 2.3: TYPICAL USES AND PROPERTIES OF THOSE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER - SPRING 1992

1) 1,1 Dichloroethane, or ethylidene chloride (CH_3CHCl_2), is a mobile liquid that is colorless and sparingly soluble in water. Some common uses are an extraction solvent and a fumigant.

2) Tetrachloroethane, or perchloroethylene ($Cl_2C:CCl_2$), is a stable, colorless liquid that is nearly insoluble in water. Some common uses are for dry cleaning and as a degreasing solvent.

3) 1,1,1 Trichloroethane, or methyl chloroform (CH_3CCl_3), is a colorless liquid, nearly insoluble in water. Common uses are metal degreasing, an ingredient in pesticides, textile processing and as a solvent for cleaning precision instruments.

4) Trichloroethene, or (tri), (CH:CCl2), is a stable, photoreactive liquid slightly soluble in water. It is used as a metal degreaser, a diluent in paints, a refrigerant and for dry cleaning.

5) Chloroform ($CHCl_3$) is colorless and heavily reactive with a characteristic odor. It is used in analytical chemistry, as a solvent, as an expansion agent in styrofoam and as a fumigant.

6) Dichloromonofluoromethane, or Freon 21, ($CHCl_2F$) is a colorless, nearly odorless, heavy gas. It is used as a refrigerant and as a solvent.

7,8) Cis or Trans 1, 2-Dichloroethene ($ClHC:CHCl_2$), is a colorless, low-boiling point liquid that exists in Cis and Trans isomers. It is slightly soluble in water and is used as a solvent, in lacquers, perfumes and thermoplastics.

9) 1,2 Dichloropropane, or propylene dichloride ($CH_3CHClCH_2Cl$), is a colorless stable liquid with a chloroform odor, nearly insoluble in water. It is used as a spotting agent, degreaser, soil fumigant for nematodes and a scouring compound.

10) Methylene chloride, or dichloromethane (CH_2CL_2), is a colorless volatile liquid with an ether-like odor. It is slightly soluble in water and is used commonly for laboratory cleaning, a solvent for degreasing and a paint remover.

11) Dichlorodifluoromethane or fluorocarbon-12 (CCl_2F_2), is a colorless non-corrosive gas, nearly insoluble in water. Common uses are as a propellant and refrigerant.

12) Trichlorofluoromethane or fluorocarbon-11 (CCl_3F) is a colorless nearly odorless volatile liquid and is used as an aerosol propellant, solvent and in fire extinguishers.

Source: Sax and Lewis, 1987

sampling events. The analytical methods used to measure the concentration of VOCs in the groundwater were EPA Method 502.2, EPA Method 624, EPA Method 8260, and EPA Method 625.

Results of groundwater sampling and testing (Appendix A) showed VOCs are present in several wells. Table 2.4 shows the EPA maximum contaminant levels (MCLs) for each compound detected during the Spring 1992 sampling event as well as the highest concentration of the respective parameters detected in a domestic or irrigation well downgradient of the landfill. No EPA maximum contaminant levels (MCL) were exceeded in samples from domestic or irrigation wells during the Spring 1992 sampling event.

The following summarizes the results of organic analyses of groundwater samples from wells in the study area.

1) A total of 40 domestic, irrigation and monitoring wells northwest of the landfill area were sampled from 1989 to 1992 to determine water quality and 22 wells were surveyed to determine groundwater elevations. Based on this survey and a water level map, it has been determined that groundwater is generally flowing northwest from the landfill through sandy, silty, gravelly strata.

TABLE 2.4. VOLATILE ORGANIC COMPOUND LEVELS IN PRIVATE WELLS NEAR HELENA LANDFILL

Constituent	EPA Maximum Contaminant Level (MCL) Parts Per Billion (PPB)	Highest Concentration found in any private water well Parts per Billion (PPB)*
Dichlorodifluoromethane	Not Listed	3.1
Trichlorofluoromethane	Not Listed	1.8
1,1-Dichloroethane	Not Listed	1.3
Total Trihalomethanes: Chloroform, Dibromomethane, Bromodichloromethane, Bromomethane	100.0 (for the sum of all)	<12.1
1,1,1-Trichloroethane	200.0	1.0
Tetrachloroethene	5.0	4.6
Trichloroethene	5.0	1.0

* Spring 1992 sampling event

2) Groundwater samples obtained from several domestic wells (potable supplies) were analyzed for volatile organic compounds (VOCs). Results of these analyses show the levels of all VOCs in Spring 1992 samples are lower than levels established by the EPA as maximum contaminant levels (MCLs) for listed priority compounds. A listed priority compound is a compound that EPA has identified because of its potential toxicological effects, and a maximum concentration has been set which should not be exceeded for drinking water.

3) Several VOCs were detected in irrigation wells northwest of the landfill. The concentrations of these compounds are very low (less than 10 parts per billion). No VOC concentration was above the EPA MCL for the irrigation wells tested in June 1992. Tetrachloroethane was detected in wells upgradient of the landfill as well as wells downgradient of the landfill. This indicates the landfill is likely not the only source of the tetrachloroethane.

4) Three VOCs, not listed by the EPA as priority compounds, were detected in various wells. Because EPA does not considered these priority compounds, there has been no EPA maximum contaminant level established for these compounds. However, EPA has set maximum concentration limits for various known and suspected toxic and carcinogenic compounds at a level higher than the concentrations of these non-priority compounds detected near the landfill. It is anticipated that when EPA limits are established for these non-priority present

I will use SST over Isopar.

compounds, these limits will be higher than the concentrations of the compounds in the tested wells.

Exhibit 2, shows the approximate lateral extent of selected organic compounds in the groundwater based on the Spring 1992 sampling event. Dichlorodifluoromethane was selected as the parameter to be plotted because of its relatively low retardation factor and because it is a common landfill contaminate. Dichlorodifluoromethane is a fluorocarbon used most extensively as an aerosol propellant for hair sprays, deodorants and many other household products. In addition, it is used as a refrigerant. The retardation coefficient for dichlorodifluoromethane in this alluvial system is approximately 1.6, or, groundwater can be expected to move 1.6 feet for every 1 foot dichlorodifluoromethane moves in the groundwater system. This difference in travel rates between groundwater and VOCs such as dichlorodifluoromethane is due to their affinity for soil particles (especially organic soil), and therefore the VOCs move at velocities less than the groundwater. Calculations for the retardation coefficient of dichlorodifluoromethane are shown in Table 2.5.

In addition to retardation, other attenuation mechanisms decrease the concentration of organic compounds as they move through the groundwater away from the source of contamination. These mechanisms are dispersion or lateral spreading of the compound, and degradation (both chemical and by micro-organisms). It is difficult to determine exactly how much effect each of these attenuation mechanisms has on a solute because

TABLE 2.5 RETARDATION OF DICHLORODIFLUOROMETHANE

Aquifer Characteristics

% Organic Carbon	=0.06 Calculated
% SOM	=0.10
Bulk density	=1.72 Calculated
Porosity	=0.35

Chemical Compound

Dichlorodifluoromethane	
Solubility equation used was log Koc -Log 280	=3.64 + .55 *
Solubility mg/l	=0.28E + 03
Log Solubility	=2.45
(Solubility was entered into program as 280 mg/l)	
Koc	=0.20E + 03
Log Koc	=2.29
Retardation Coefficient	=1.6
Rf value	=0.6403

Solubility equivalents based on molecular weight of 120.92

mg/l	micromoles/l	mole fraction
0.2800E + 03	0.2316E + 04	0.4171E -04

Logs of above solubilities

2.4472	3.3647	-4.3797

Source: Oklahoma State University, Dr. Hanslow, 1988.

many factors such as solute concentration, aquifer characteristics, and geochemical factors are involved.

A sanitary landfill has a relatively simple mechanism of leachate production. In general, water percolates into, or is initially present in landfill refuse and creates a solute or a leachate. Residual water and chemicals present during landfilling could include partially filled containers of paint, lacquer, cleaning fluids, aerosols, plastics, organic products and free liquid chemicals. Containers either break and release the chemicals immediately, or slowly rust and release the chemicals over time. Additional landfilled chemicals could include pesticides, fumigants, fuels, oils and many others (Sax and Lewis, 1987).

Some of the chemical compounds commonly found in landfill leachate are dichlorodifluoromethane, trichlorofluoromethane, trichloroethane, 1-2-dichloroethene, methylene chloride, and tetrachloroethane. Dichlorodifluoromethane and trichlorofluoromethane were commonly used as aerosol propellants (Table 2.3). 1-2-Dichloroethene (both in cis and trans isomers) is commonly used as a household lacquer and trichloroethene is commonly used to dilute paint. Methylene chloride is commonly used as a paint remover. Tetrachloroethane is used in dry cleaning and as a degreasing solvent. The production of tetrachloroethane alone exceeded 300 thousand tons per year in the United States in 1982 (Moore and Ramamoorthy, 1984).

In addition to landfill leachate generation, additional sources of organic compounds

present in the groundwater in the vicinity of the landfill are likely. Irrigation wells near the landfill were sampled and showed low levels of tetrachloroethane and chloroform. These include wells 28, 34 and 24 (see Exhibit 1). A source of organic contaminants upgradient of these wells is likely adding to the low levels of organic compounds in the groundwater. The source of these compounds is unknown, however, dry cleaners, service stations or other industrial facilities in the Euclid Avenue area could be the potential source of the low levels of tetrachloroethane. Chloroform (and the low levels of other trihalomethanes) in the groundwater could be in part the result of lawn watering with City of Helena water or leaky sanitary sewer lines. Analysis showed concentrations of trihalomethanes in three city water samples below the EPA MCL, but were in the 90 parts per billion range, which is well above any concentrations found in the groundwater. In addition to trihalomethanes in city water, chlorinated water discharged in sanitary sewers from the YMCA and city pool could seep into the groundwater and create chloroform. Humic and fulvic acids (commonly present in organic soils) have the required structural and functional arrangements for a haloform reaction (Moore and Ramamoorthy, 1984). Sanitary sewer pipes from the city pool are designated by the City as class 2 pipelines. The classification system ranges from Class 1, sewage pipes that are heavily dilapidated, to class 5, sewage pipes that have been recently replaced.

As discussed in Section 2.2, the city storm drain is likely creating a groundwater mound in the landfill area. A portion of this groundwater could be percolating through refuse, and it also may initially contain organic compounds from the storm drainage area which is Last Chance Gulch. Samples of this storm drain water obtained previously by EPA showed low levels of VOCs.

Generally, storm drainage is poor in quality because it contains street runoff which significantly degrades water. In addition, there could possibly be illegal discharges into city drains. Sanitary sewer pipes upgradient of monitoring well HL-1 are in poor condition and are designated by the City as class 1 pipes. These pipes were installed in the late 1800s and are dilapidated. A water sample obtained from monitoring well HL-1 and analyzed for coliform bacteria (a bacteria present in the feces of warm blooded animals) showed significant contamination. Because of this problem, these dilapidated pipes were placed on an expedited replacement plan by the City.

2.3.2 Inorganic Water Quality

Inorganic water quality beneath and peripheral to the Helena landfill (Appendix B) also indicates a plume is present. Chloride concentrations and specific conductivity are elevated in the landfill vicinity and decrease in concentration downgradient of the landfill. The total dissolved solids concentration in groundwater in the landfill vicinity (Appendix B) is slightly higher than the secondary drinking water standard of 500 mg/l. Nitrate plus nitrite is present in groundwater in several wells and has historically exceeded 10 mg/l in monitoring wells completed in the landfill (Appendix B). Concentrations of other major minerals appear to be elevated in the vicinity of the landfill. These elevated levels are likely due to the landfill as well as other upgradient sources. Concentrations of dissolved metals in the groundwater show no apparent water quality change in the vicinity of or downgradient of the landfill.

3.0 COVER SOIL

The type of soil used for covering landfill refuse is very important in controlling landfill leachate. The cover soil used for the City of Helena Landfill closure meets all requirements set forth by the State of Montana (ARM Title 16, Chapter 14, Subchapter 5, Section 16.14.521(2), and the MDHES document of April 3, 1991, entitled "Class II Landfill Closure Requirements and Recommendations" as well as the Subtitle D requirements for cover soil as presented in 40 CFR Part 258, Section 258.60. The cover will consist of two layers as specified in Subtitle D. These two layers are the infiltration layer and the erosion layer. The infiltration layer is discussed in the following section, and the erosion layer will be discussed with the vegetation plan in Section 4.2.

3.1 SOURCES AND PHYSICAL CHARACTERISTICS OF THE INFILTRATION LAYER COVER SOIL

Two cover soil sources are being utilized in the final cover infiltration layer for the City of Helena Landfill. These two sources are the Walmart construction site east of town and the "Site E" proposed landfill site about 10 miles northeast of town. These sources and the physical characteristics of the soils utilized from each source are discussed in the following sections.

3.1.1 Walmart Construction Site Soil

The cover soils borrowed from the Walmart Construction Site east of Helena generally

consist of sandy clays with occaisional gravels. These soils were borowed on a selective basis with the more clayey soils used for cover material. A composite sample of this material was collected and submitted to the Braun Intertec Laboratory in Billings for standard proctor and permeability testing. This material was classified by the laboraotry as a sandy lean clay with gravel. The standard proctor test determined that the maximum dry density of the soil was 112.5 pounds per cubic foot (pcf). A portion of the submitted material was remolded to a density of 103.4 pcf (approximately 90% of standard proctor maximum density) and both constant and falling head permeability tests according to ASTM D 5084 were run on the soils. The resultant calculated permeabilities from these tests ranged from 4.1×10^{-7} cm/sec to 4.2×10^{-7} cm/sec (Appendix C). These calculated permeabilities were well below the Subtitle D criteria of 1×10^{-5} cm/sec. The permeability of the cover soil will be verified in the field by performing nuclear gage testing of the in-place density of the material and other methods as detailed in Section 3.2. The 90% standard proctor density which was used for the permeability testing in the laboratory should be easily obtainable in the field.

3.1.2 "Site E" Soil

The cover soil material borrowed from the "Site E" proposed landfill site has been extensively studied during the permitting process for the new proposed City/County landfill. This soil typically ranges from sandy clays to clayey sands. Several in-situ and ex-situ hydraulic conductivity and permeability tests were performed on these soils as part of the permitting process. Three "pump-in" tests (Appendix C) that were performed in test pits in these soils are described in the permit application. These three tests

revealed hydraulic conductivities of the soils in-place ranging from 1.2×10^{-7} cm/sec to 6.8×10^{-7} cm/sec (Appendix C). In addition, two triaxial permeability tests were performed on two samples of this material according to the Army Corp of Engineers Manual Method EM 110-2-1906, Appendix VII. These test resulted in calculated permeabilities of these soils ranging from 1×10^{-7} cm/sec to 2×10^{-8} cm/sec (Appendix C). These soils exhibit permeabilities far below the 1×10^{-5} cm/sec criteria established by the EPA in the Subtitle D regulations.

3.2 INFILTRATION LAYER SOIL REQUIREMENTS AND QUALITY CONTROL

Montana Administrative Rule ARM 16.14.521 and the MDHES document of April 3, 1991 require that at least two feet of cover soil with a permeability of less than 1×10^{-3} cm/sec be applied over all areas which have received landfill materials. In addition, the Subtitle D requires that all landfill areas that receive wastes on or after October 9, 1991, shall be covered with 18 inches of cover soil that is of equal or less permeability as the soils underlying the landfill, or having a permeability of 1×10^{-5} cm/sec or less, whichever is less. These requirements will be ensured by the following methods.

1. Double Ring Infiltration Tests - Double ring infiltration tests will be performed on cover soils to determine in-place infiltration rates after they are compacted in place. Approximately eight to ten double ring infiltration tests will be performed on the cover soil in place.

2. Nuclear Gage Density Tests - Soil density will be measured with a nuclear gage

each time a double ring infiltration test is performed. This will allow a correlation between soil density and infiltration rates. In addition, soil density will be measured on approximately a 200 foot grid basis.

3. Laboratory Remolded or Shelby Tube Permeability Tests - Approximately 3 to 5 samples will be tested by a professional laboratory. The number of samples will be based on the material being used for the cover soil.

The depth of all in-place cover soil will be verified by inspections by a city engineer. All grades will be staked by the engineer prior to placement of the soils, and cover soil placement activities will be documented and approved by the engineer.

4.0 FINAL COVER DESIGN

The final cover for the City of Helena Landfill has been designed as per the State of Montana Class II Landfill Closure Requirements and Recommendations (April 3, 1991) and Subtitle D cover design criteria. Proposed future land use, maintenance and monitoring have all been considered in the final cover design.

4.1 DRAINAGE - RUNON/RUNOFF PLAN

Exhibit 3 shows the final grading and drainage plan for the completed cover on the Helena Landfill. This plan allows precipitation to runoff quickly and efficiently away from all areas which contain buried refuse. The cover topography of the landfill, and the drainage ditch system peripheral to the landfill were designed to eliminate surface runon. Runoff from the Last Chance Gulch area, however, drains under the landfill in the city storm drain running below the landfill. To eliminate potential recharge to the landfill from this source, the drain will be extended to discharge further away from the landfilled areas. This extension is detailed in Section 4.1.1 of this closure plan.

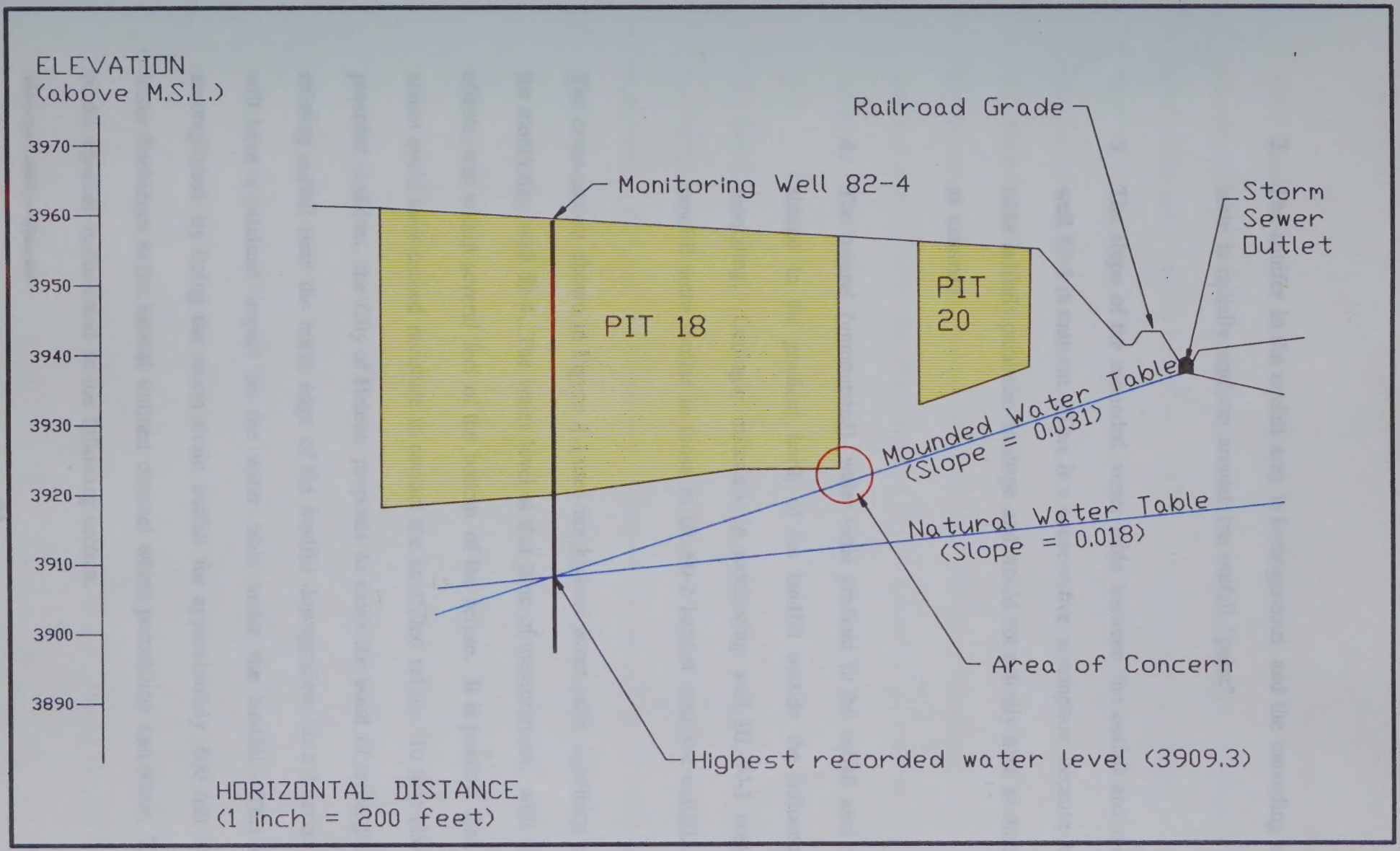
This drainage plan considers the drainage plan designed by Damschen and Associates for the proposed transfer station which may be located at the present landfill site. This is contingent on the City's selected waste disposal alternative for after the present landfill no longer accepts waste.

4.1.1 Extension of the City Storm Drain

Springtime flows for the Last Chance Gulch area storm drain outfall located just north of the landfill were measured in 1990 and 1991. These flow measurements are shown in Appendix A. Flows from the outfall ranged from 52 gallons per minute (gpm) to 81 gpm and all flow typically percolates into the ground within the first 200 feet of the channel below the outfall. This channel is excavated to the north of the landfill along the east side of Bill Roberts Golf Course. The water which seeps into the ground causes a mounding effect on the local water table that could potentially saturate refuse or recharge the aquifer with poor quality storm runoff water.

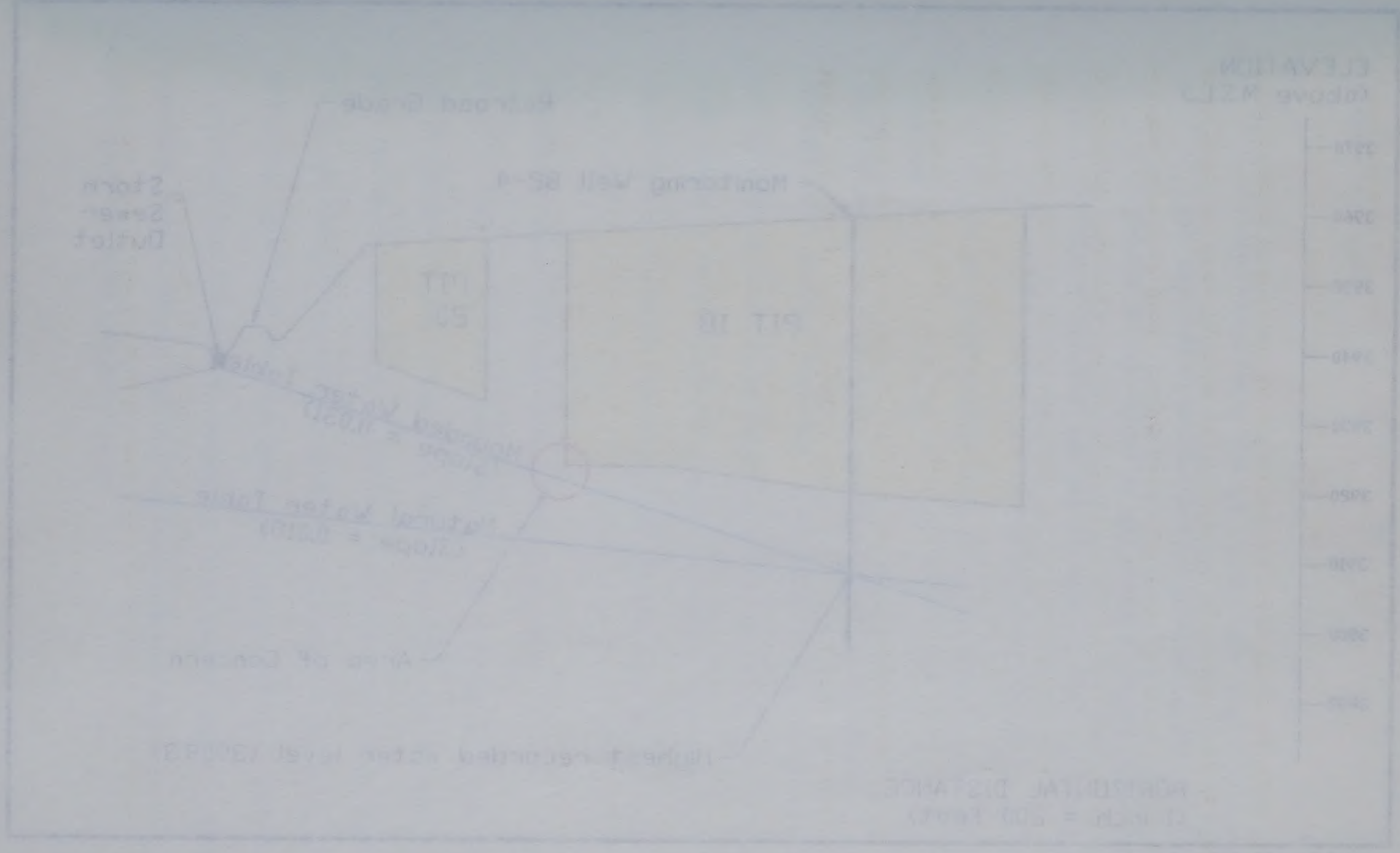
Figure 4.1 is a cross-section which shows the mounded water table (under high water table conditions) and its relationship to the landfill cell area. This cross-section suggests that the northwest corner of the landfill cell number 18 has the highest potential to be impacted by the mounded water table. It is important to note that several assumptions have been made in the preparation of this cross-section. These assumptions are outlined as follows:

1. That the outfall from the storm drain is essentially a point recharge to the groundwater system. This requires that the storm drain running beneath the landfill is competent and that no leakage occurs. The storm drain was inspected by city workers in 1990 (personal communication, Dick Nisbet, May 1991) and no leakage was observed in the concrete section above the location of the outfall near the northern most railroad track (Exhibit 1).



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Figure 4.1: Cross-Section of Storm Sewer Outfall Area



2. The aquifer in the outfall area is homogeneous and the mounding the water table is radially uniform around the outfall "point".

3. The slope of the mounded water table between the outfall and monitoring well 82-4 is uniform. This is a conservative assumption because the water table is likely parabolic in shape and would not actually have as much impact as assumed.

4. The natural (unmounded) water table gradient in the outfall area would be similar to the gradient north of the landfill outside the influence of the mounding. Geologic materials in monitoring well HL-90-1 north of the landfill were similar to those in HL-90-2 located near the outfall.

The cross-section shown in Figure 4.1 uses the highest water table condition on record for monitoring well 82-4. The water level at that time of measurement, with mounding effects, was within several feet of the bottom of the refuse. It is possible that capillary action could have caused moisture to contact the landfilled refuse. To help alleviate this potential problem, the City of Helena proposes to move the point of recharge from the existing outfall near the north edge of the landfill downgradient to a location where it will have a minimal impact on the water table under the landfill. This would be accomplished by lining the storm drain outfall for approximately 600 feet before the water discharges to the natural unlined channel where percolation can occur. The design of the channel is discussed in the following section.

4.1.2 Design of Storm Drain Extension

The channel extension consists of a two-phase channel design, including a low-flow channel designed to pass base flows and an artificial flood-plain terrace to pass flood flow. The base flow portion of the channel will be lined with a synthetic liner material. The overall length of the new section of channel is approximately 500 feet with a slope of 0.015 ft/ft. The estimated base or low design flow is approximately 0.5 cfs (cubic feet per second) or 225 gpm (gallons per minute). The design flood flow value is 391 cfs which is derived from the flow capacity of the immediately upstream culvert that discharges to the new channel.

The low-flow section of channel is triangular in shape, has a maximum flow depth of 0.5 feet, 10 to 1 side slopes and has a top width of 10 feet. The artificial flood-plain section is trapezoidal in shape, has a maximum flow depth of 2.95 feet, 2.5 to 1 side slopes and has a top width of 24.8 feet. Riprap will be used in both channel phases and will have a d^{50} of 8.3 inches. The maximum riprap diameter is 12.5 inches and the riprap layer thickness is 18 inches.

The Manning's roughness coefficients used for the channel design was increased by 10% to allow for suspended material and debris, plus increased bedload volumes accompanying flood flows. This in effect calls for a deeper channel, thus ensuring containment of flood flows. A design safety factor of 1.5 was applied for channel freeboard. The design freeboard is 0.5 feet, bringing the total channel depth to 3.95 feet with a total top width of 29.8 feet. Flow regimes in both phases are subcritical. A

schematic of the two-phase channel design is shown on Figure 4.2 and the calculations are shown in Table 4.1. The new channel is designed to extend 390 feet from the existing concrete bulkhead under the railroad track. The final design of the channel will be performed by the City of Helena Engineering Department.

After completion of the new storm drain extension, water levels in peripheral monitoring wells and piezometers will be carefully monitored to assess the impacts of the storm drain extension.

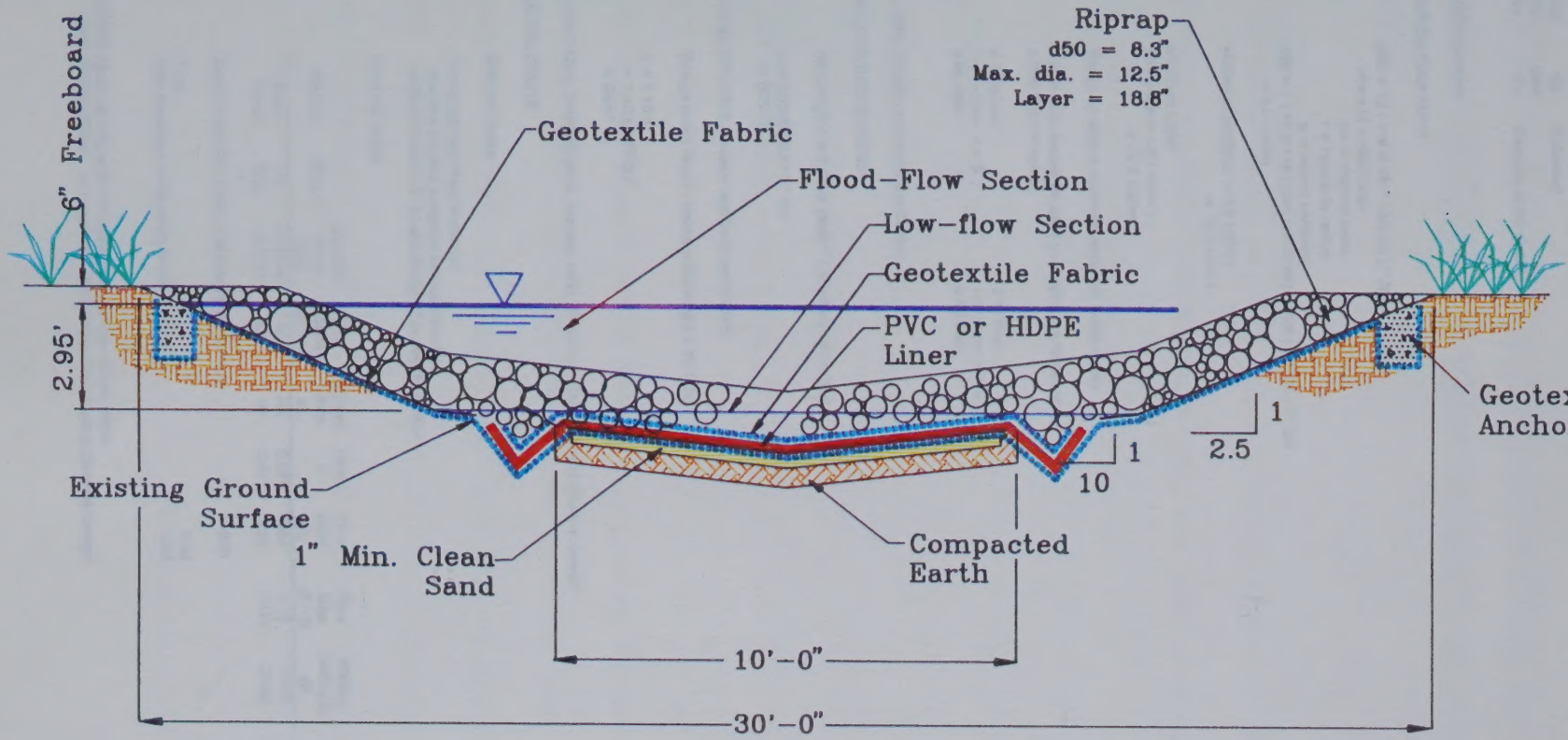
4.2 EROSION LAYER AND VEGETATIVECOVER

Subtitle D regulations require that at least six inches of topsoil be placed above the infiltration layer soil to protect the cover from erosion and desiccation. The regulations also specify that this soil be capable of sustaining "native vegetation". This topsoil layer for the Helena Landfill will be from the "Site E" borrow source located to the north of the City. The soil consists of clayey sand, to sandy clay and is referred to by the Soil Conservation Service (SCS) as the Weingart Assiniboine Complex. These soils will be borrowed and segregated on a selective basis and the coarser materials more suited to sustaining vegetation will be used for the erosion layer. According to SCS data (included in Appendix D the texture, pH, salinity, organic matter content appear adequate to sustain vegetation with proper fertilization. The current landuses for these soil types according to the SCS are as non-irrigated and irrigated crop land. Crops currently grown on these soils include spring wheat, winter wheat, barley, alfalfa hay, grass legume hay, and native pasture. In addition, the City will have a fertility test run on the soil to

schematic of the trapezoidal channel design is shown on Figure 4.2 and the calculations are shown in Table 4.1. The new channel is designed to extend 390 feet from the existing concrete bulkhead under the railroad track. The final design of the channel will be performed by the City of Tiburon Engineering Department.

After completion of the new storm drain extension, water levels in peripheral monitoring wells and piezometers will be carefully monitored to assess the impacts of the storm drain extension.

4.3 [illegible]VEGETATIVECOVER



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Rev Date:	4/9/93

Figure 4.2:
Storm Sewer Extension Cross-Section

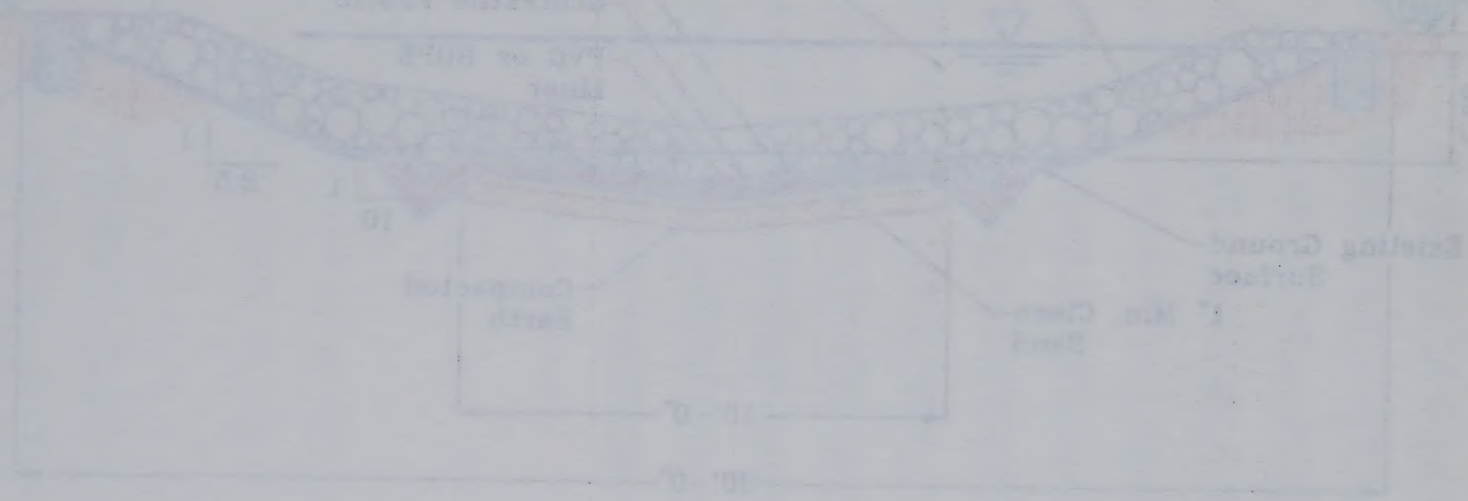


TABLE 4.1 CHANNEL DESIGN CALCULATIONS

CITY OF HELENA
Helena Landfill Project

HYDROLOGY
Channel Design

Parameters	Value	Unit	Source
Length of channel	490	ft	Air photo
Slope of channel	0.0148	ft/ft	Bulkhead outlet - midway between sections 8 & 9
Base flow	0.446	cfs	Estimated
	200	gpm	
25 yr flood flow	391	cfs	Capacity of 60" R.C.P.

Channel Capacity Calculations

I. RIPRAP CALCULATIONS

1. $d50 = 12 (118 Q Sb^{13/6} r/p)^{2/5}$
   where Q = discharge
   Sb = channel slope
   r = Hydraulic radius
   p = wetted perimeter
   $d50 = [(12)(118)(391)(0.0148)^{13/6} (0.0805)]^{2/5}$
   = 8.3 inches

2. Maximum diameter = 1.5 (d50)
   = 12.5 inches

3. Minimum Layer
   Thickness = 1.5 (dmax)
   = 18.8 inches

4. Riprap up side to maximum expected depth of flow

5. A filter cloth should be used underlying the riprap, or a filter blanket using:

   $\frac{\text{d 15 rirprap}}{\text{d 85 filter}} <= 5$; $\frac{\text{d 15 filter}}{\text{d 85 base}} <= 5$

SOURCE: EPA, 1976. Erosion and Sediment Control.

II. MANNING'S N CALCULATION

1. Manning's n = 0.0395 (d50) ^ 1/6, where d50 in feet

   $n = 0.0395 (0.67)^{1/6}$
   = 0.0372

   SOURCE: EPA, 1976. Erosion and Sediment Control.

2. Design safety factor - increase Manning's n by 10%

   n = 1.10 n
   = 1.10 (0.0372)
   = 0.041

   SOURCE: CIVIL ENGINEERING, January 1990. "Rethinking Flood-Control Channel Design".

III. CHANNEL DESIGN

1. Channel shape

   Two-stage flow-channel design:
   - low-flow channel designed to pass base flow
   - artificial flood-plain terrace designed to pass flood flow

2. Channel Design

Section	Shape	Channel Slope (ft/ft)	Side Slope (H:1V)	Bottom Width (ft)	Manni n	Flow depth (ft)	Flow Area (ft^2)	Wetted Perimeter (ft)	Calc Flow (cfs)	Top Width (ft)	Avg Velocity (fps)	Frude Number
Base	Tri	0.0148	10	NA	0.041	0.50	2.50	10.05	4.37	10.0	1.7	0.62
Flood	Trap	0.0148	2.5	10	0.041	2.95	53.76	25.94	386.35	24.8	7.2	0.86
Depth in low-flow channel at design low-flow q =						0.21						
Total						3.45			390.72	24.8		
With freeboard using safety factor = 1.5						3.95				29.8		

SOURCE: Manning's Equation for Open Channel Flow. Chow, 1964.
CIVIL ENGINEERING, January 1990. "Rethinking Flood-Control Channel Design".

determine a proper fertilization rate to maximize the soil's fertility. Based on this test, a fertilization rate will be recommended by a qualified soil scientist and implemented by the City.

Based on conversations with the SCS and recommendations from Nate Halubka, who has extensive experience with reseeding reclaimed areas as an employee with Grasslands, Inc., the following seed mix per acre is suggested:

5 lbs fairway crested wheatgrass

5 lbs durar hard fescue

2.5 lbs slender wheatgrass

3.5 lbs Canada wheatgrass

This seed mixture is based on the drill seeding method, if broadcast seeding is required, the seed mixture will have to be doubled. This vegetation plan is also contingent on the final usage for the reclaimed landfill site. Any changes in the vegetation plan will be submitted to the MDHES for approval before being implemented. Potential future usage of the reclaimed landfill is discussed in Section 7.0 of this closure plan.

5.0 CLOSURE CERTIFICATION

Prior to final closure of the Helena Landfill, the City of Helena will notify users via public announcement, and an alternative disposal facility will be named. This alternative disposal facility has not been officially selected at this time. This closure plan will also be made available for public inspection. Access will be restricted to all areas to prevent refuse disposal and cover damage unless future landuse activities are proposed by the City of Helena and approved by MDHES. Access will only be allowed to the transfer station once it becomes operational. The MDHES will be notified immediately when the City of Helena will no longer accept waste. After final closure activities are complete, the MDHES will be sent documentation that closure has been completed according to the approved closure plan. This documentation will be certified by a professional engineer.

The landfill closure shall be considered an "interim closure" until it is approved in writing by a solid waste program inspector from the Solid and Hazardous Waste Bureau of the Montana Department of Health and Environmental Sciences. When such notice is given, the landfill will be declared officially closed and the City of Helena shall surrender their Solid Waste Management System License for this site to the MDHES. The time schedule for the final closure activities is dependent on the selected disposal alternative however, the Helena Landfill does not anticipate accepting waste on or after October 9, 1993.

6.0 POST CLOSURE MAINTENANCE AND MONITORING

Post closure maintenance and monitoring are necessary to ensure the long term integrity of the landfill cover. This post closure maintenance and monitoring plan fulfills the requirements set forth by the State of Montana's Class II Landfill Closure Requirements and Recommendations (April 3, 1991).

6.1 VISUAL INSPECTION - EROSION, SETTLING AND VEGETATION CONTROL

The landfill cover and drainage ditch system will be inspected annually (the annual inspection will occur in late spring) and after major rain events to determine its integrity. The inspection will consist of checking for erosion, differential settling, and washing out of vegetation. Rills forming in the cover will be repaired to original grade and reseeded. Erosion controls such as geofabrics, straw dams, etc. may be implemented to control problem areas.

The cover will also be inspected for extensive differential settling. Differential settling could potentially result in ponded areas on the landfill cover, resulting in leachate production. Problem areas will be regraded to original grade and reseeded.

Drainage ditches will also be maintained after the landfill is closed. Ditches will be inspected during the routine annual inspection for blockage or excessive erosion and erosion will be controlled with riprap, liners, or other acceptable measures. Culverts will be cleaned when necessary to maintain proper flow in the ditches.

Repairs to the landfill cover and ditches will be performed as soon as possible after problems are discovered to avoid major damage to the cover. Small problems such as erosional rills and washed out vegetation can be handled very quickly, whereas larger problems may require more investigation and design to mitigate.

This visual inspection portion of the post-closure maintenance and monitoring plan will be ongoing until such time as the MDHES deems necessary to ensure that conditions are stable and potential for problems is minimized.

6.2 GROUNDWATER MONITORING

This post-closure groundwater monitoring plan fulfills the requirements as set forth by the State of Montana Administrative Rules, Title 16, Chapter 14, Sub-Chapter 7 - Proposed Groundwater Monitoring Rules For Landfills in Montana, and the Montana Class II Landfill Closure Requirements and Recommendations (April 3, 1991). Groundwater sampling and reporting will be performed by or under the direction of the recently established City/County water quality district.

The proposed water quality sampling schedule for the City of Helena Landfill (Table 6.1) incorporates the comments of the MDHES and the City/County Health Department. Parameters that would be analyzed are in the analytical schedule on Table 6.2. The parameter list is based on the landfill groundwater monitoring requirements developed by MDHES.

TABLE 6.1 WATER QUALITY ANALYTICAL SCHEDULE

Well Number	Analysis	Date
83-6	Phase I Parameters	Spring, Fall
HL90-1	Phase I Parameters	Spring, Fall
HL90-2	Phase I Parameters	Spring, Fall
HL90-3	Phase I Parameters	Spring, Fall
40	Phase I VOCs	Spring, Fall
31	Phase I VOCs	Spring, Fall
5	Phase I VOCs	Spring, Fall
13	Phase I VOCs	Spring, Fall
75	Phase I VOCs	Spring, Fall
EPA-1	Phase I VOCs	Spring, Fall
59	Phase I VOCs	Spring, Fall
52	Phase I VOCs	Spring, Fall

? 48 Custer Ave, Wolf Benton

Note: Because private well are sometimes difficult to access, nearby wells may be substituted, if necessary.

TABLE 6.2 GROUNDWATER MONITORING PARAMETERS

1. Ammonia (as N)
2. Bicarbonate (HCO_3)
3. Calcium
4. Carbonate
5. Chloride
6. Iron
7. Magnesium
8. Manganese, dissolved
9. Nitrate (as N)
10. Potassium
11. Sodium
12. Sulfate (SO_4)
13. Chemical Oxygen Demand COD)
14. Total Dissolved Solids
15. Total Suspended Solids
16. Specific Conductance
17. pH
18. Arsenic
19. Barium
20. Cadmium
21. Chromium
22. Cyanide
23. Lead
24. Mercury
25. Selenium
26. Silver

27. The following volatile organic compounds (VOCs by EPA Method 8240): 8260

- Benzene
- Bromochloromethane
- Bromodichloromethane
- cis-1,3-Dichloropropene
- Trans-1,3-Dichloropropene
- 1,4-Difluorobenzene
- Ethylbenzene
- Ethyl methacrylate
- 4-Bromofluorobenzene
- Bromoform
- Bromomethane
- Carbon tetrachloride
- Chlorobenzene
- Chlorodibromomethane
- Chloroethane
- 2-Chloroethyl vinyl ether
- Chloroform
- Chloromethane
- Dibromomethane
- Dichlorodifluoromethane
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- Iodomethane
- Methylene chloride
- 1,1-Dichloroethene
- trans-1,2-Dichloroethane
- Styrene
- 1,1,2,2-Tetrachloroethane
- Toluene
- 1,1,1-Trichloroethane
- 1,1,2-Trichloroethane
- Trichloroethene
- Trichlorofluoromethane
- 1,2,3-Trichloropropane
- Vinyl acetate
- Vinyl chloride
- Xylene

Tetrachloroethene (PCE)

NOTE: Phase I parameters include all parameters listed above.
Phase I VOC's include parameters listed in item number 27.

u:\sdowns...chhl01\revclose.skd

All samples will be obtained using documented and accepted sampling techniques. One duplicate and one blank sample will be obtained and analyzed per sampling event for quality control and quality assurance. Monitoring results will be submitted to the MDHES and City/County Health Department by the water quality district when the results are obtained and validated.

6.3 METHANE MONITORING

Methane monitoring in the vicinity of the Helena Landfill has been performed since the early 1980's. Early monitoring consisted of combustible gas surveys in monitoring wells HL-1 through HL-7 and the basements of the YMCA and State Armory Buildings. During this time the highest concentrations of methane were observed in well HL-4 and range from 2.2 to 6.4% (personal communication, Fritz Zettal, City of Helena Fire Department, January 1990). Results of recent methane monitoring at the Helena Landfill are discussed in the "Helena Landfill 1992 Annual Report on Groundwater and Methane Monitoring" which was submitted to MDHES in August 1992.

At the request of MDHES, a new program encompassing the northern part of the landfill area was implemented in Spring 1991 and this program was expanded in 1992 at the request of the MDHES. The present methane monitoring program includes quarterly monitoring of 14 monitoring wells and 5 structures as shown on Table 6.3. This program was approved by the MDHES in a November 1991 letter to the City. The MDHES did however, suggest that several dedicated methane monitoring probes be installed to increase the monitoring around the periphery of the landfill.

TABLE 6.3: SUMMARY OF METHANE MONITORING SITES

LOCATION	SITE CONDITIONS
MPC Office (In basement)	Office Basement
YMCA (In sub-basement)	In building's sub-basement
Armory (In basement)	In basement of armory building
82-3*	Adjacent to Helena Landfill shop
HL90-3*	SW edge of present active landfill
HL90-1*	NW of present active landfill
HL90-2*	North of present active landfill
82-2*	NE edge of present active landfill
EPA-1*	NE edge of Phase I landfill
83-7*	North edge of Phase I landfill
EPA-4*	North edge of Phase II landfill
HLP91-1*	North of present active landfill
Elk River Concrete Shop	West of present active landfill
Landfill Office (at scalehouse)	In present Scalehouse Building
Landfill Shop	In present Shop Building
HL-1*	South of Phase I landfill
HL-7*	North of present active landfill
I-5*	West of present active landfill
I-6*	NW edge of Phase II landfill
EPA-2*	North of YMCA building In Phase I landfill
Calibration Standard (typically 100 ppm methane)	100 ppm methane calibration standard
***PROPOSED METHANE MONITORING PROBES AS SHOWN ON FIGURE 6.1	Peripheral to all landfilled areas as shown on Figure 6.1

* Groundwater monitoring well or piezometer

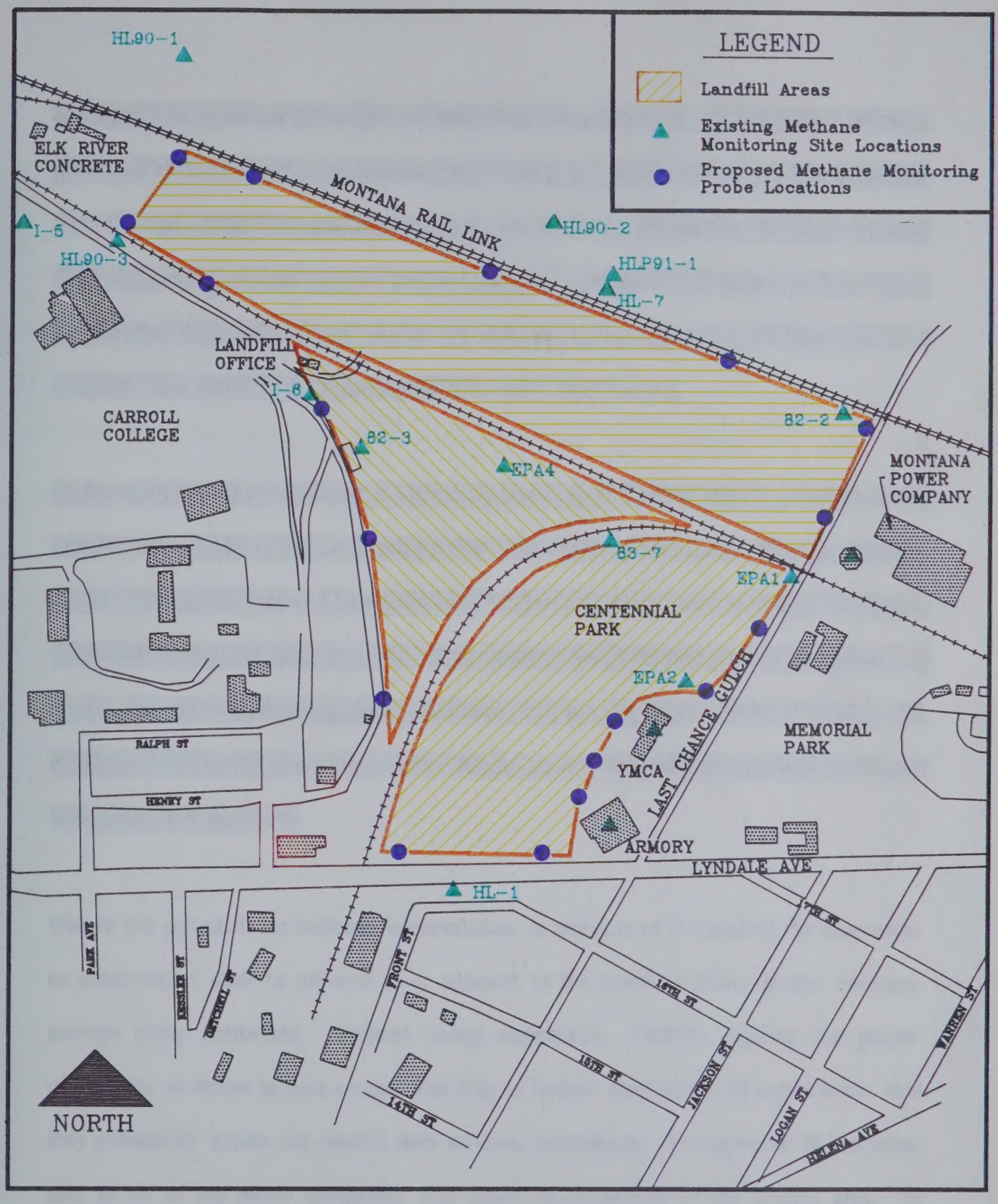
*** Proposed monitoring probe locations as shown on Figure 6.1

NOTE: All methane monitoring site locations are shown on Figure 6.1

In response to the MDHES' request, the City has revised the present methane monitoring program to include all of the present monitoring locations as well as the proposed new methane monitoring probes as shown on Figure 6.1. These probe locations were chosen based on the location of present monitoring locations and the proximity of inhabited dwellings. Probe spacing is denser near inhabitable dwellings.

The new methane monitoring probes will be installed after probe locations presented in this document are approved by the MDHES. The probes will be installed by drilling a bore hole (hole depth will be based on the depth of garbage within a 500 foot radius of the probe location) and placing a perforated or slotted 1/2 inc PVC pipe into the hole. The bottom 4 to 5 feet of the pipe will be perforated or slotted and the remainder of the pipe to the surface will be solid. A sand pack of clean, coarse silica sand will be placed around the slotted portion of the pipe. The annular space above the sandpack will be sealed with a bentonite grout. The probes will be protected by a steel protective casing with a locking lid. If probes deeper than 20 feet are necessary, then two probes will be placed in the hole; one to monitor near the bottom of the hole and, the other to monitor halfway to the surface. This will help to ensure that the entire vadose zone is being monitored for gas migration. The probes will be capped with an airtight cap with a sampling access tube which can be valved or clamped shut between monitoring events.

Methane monitoring will be performed by the City Fire Department with a calibrated combustible gas indicator or organic vapor analyzer which has been calibrated according to product specifications.



Proj. No:	CHHL01
Dwg. No:	HLF2592S
Scale:	1" = 500'
Date:	3/23/93
Rev Date:	4/9/93

Figure 6.1:

Existing and Proposed Methane Monitoring Sites



Sampling will consist of extracting and analyzing one probe bore volume of air from each probe. Both the highest concentration read during this purge and the reading after one bore volume of air has been removed will be recorded. In addition to sampling with field equipment, at least one air bag sample per event will be obtained and sent to a professional laboratory for a natural gas analysis. This laboratory analysis will help correlate and validate the results obtained in the field survey.

Methane monitoring will occur at all monitoring locations on at least a quarterly basis. Special consideration will be given to field conditions in scheduling these monitoring events. The monitoring will be scheduled when possible to coincide with field conditions conducive to methane migration (ie. rain or snow covered surface, frozen ground etc...). Monitoring performed under these conditions may provide more conservative data and help provide "worst case" information as an added safeguard for nearby residents, businesses and facilities.

Due to the potential for methane accumulation in any part of the landfill, no excavation or construction shall be allowed in or adjacent to the landfill without proper methane surveys being performed. Federal safety regulations, (OSHA), outline the proper procedures to follow in such a case. The City of Helena shall notify all departments that may potentially access the landfill area of these procedures. In Appendix D is a letter sent to all of the utility companies that could be excavating in the landfill area. In addition, this letter was also sent to Carroll College, Elkriver Concrete, and necessary City of Helena personnel.

7.0 FUTURE LAND USE

The City of Helena has designated no specific use for the reclaimed landfill area at this time. A personal communication with Mr. Randy Lilje of the City of Helena Parks Department in June 1991, indicated that the land use currently being considered (but not committed to) would be a grassed park area similar to that of Centennial Park. This use would dictate that irrigation of the grass would need to be implemented and a soil moisture and water balance control system similar to that at Centennial Park would need to be implemented. Final land use will be determined by the City after all possible options have been evaluated.

8.0 REFERENCES

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APPENDIX A.

HELENA LANDFILL AREA WATER QUALITY

APPENDIX A - SUMMARY OF WATER QUALITY ANALYSES
CHHL01 - City of Helena - Hlna Landfll Mtrng

Sample Type: Irrigation Well

SITE CODE	I-3 — golf course
SAMPLE DATE	05/08/90
SAMPLE TIME	11:40
LAB	EL
LAB NUMBER	90-12196
REMARKS	Golf Course W
SAMPLE NUMBER	HL-9005-116

-- VOLATILE ORGANICS --	
1,1,1,2-TETRACHLOROETHANE	<0.001
1,1,1-TRICHLOROETHANE	0.0026
1,1,2,2-TETRACHLOROETHANE	<0.001
1,1,2-TRICHLOROETHANE	<0.001
1,1-DICHLOROETHANE	0.0017
1,1-DICHLOROETHENE	<0.0005
1,1-DICHLOROPROPENE	<0.001
1,2-DIBROMOETHANE	<0.001
1,2-DICHLOROETHANE	<0.0005
1,2-DICHLOROPROPANE	<0.001
2,2-DICHLOROPROPANE	<0.001
2-CHLOROTOLUENE	<0.001
4-CHLOROTOLUENE	<0.001
BENZENE	<0.0005 — MCL .005 mg/L
BROMOBENZENE	0.001 — no MCL
BROMOCHLOROMETHANE	<0.001
BROMODICHLOROMETHANE	<0.001
BROMOFORM	<0.001 — MCL .1 mg/L
BROMOMETHANE	<0.001 — no MCL
CARBON TETRACHLORIDE	<0.0005 — .005 mg/L
CHLOROBENZENE	<0.001
CHLOROETHANE	<0.001 — no MCL
CHLOROFORM	0.0038 — MCL .1 mg/L
CHLOROMETHANE	0.001 — no MCL
CIS-1,2-DICHLOROETHENE	0.0011
CIS-1,3-DICHLOROPROPENE	<0.001
DIBROMOCHLOROMETHANE	<0.001
DIBROMOMETHANE	<0.001 — no MCL
DICHLORODIFLUOROMETHANE	0.0052 — no MCL
ETHYLBENZENE	<0.001
M-XYLENE	<0.001
O-XYLENE	<0.001
P-XYLENE	<0.001
METHYLENE CHLORIDE	0.0011
STYRENE	<0.001
TETRACHLOROETHENE	0.007

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).

Sample Type: Irrigation Well

SITE CODE	I-3
SAMPLE DATE	05/08/90
SAMPLE TIME	11:40
LAB	EL
LAB NUMBER	90-12196
REMARKS	Golf Course W
SAMPLE NUMBER	HL-9005-116
— VOLATILE ORGANICS —	
TOLUENE	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001
TRICHLOROETHENE	0.0011
TRICHLOROFLUOROMETHANE	<0.001
VINYL CHLORIDE	<0.0005
— SEMI-VOLATILE EXTRACTABLES —	
1,2,3-TRICHLOROBENZENE	<0.001
1,2,3-TRICHLOROPROPANE	<0.001
1,2,4-TRICHLOROBENZENE	<0.001
1,2,4-TRIMETHYLBENZENE	<0.001
1,2-DIBROMO-3-CHLOROPROPANE	<0.001
1,2-DICHLOROBENZENE	<0.001
1,3,5-TRIMETHYLBENZENE	<0.001
1,3-DICHLOROBENZENE	<0.001
1,3-DICHLOROPROPANE	<0.001
1,4-DICHLOROBENZENE	<0.0005
DICHLOROMONOFLUOROMETHANE	0.0039
HEXACHLOROBUTADIENE	<0.001
ISOPROPYLBENZENE	<0.001
N-BUTYLBENZENE	<0.001
N-PROPYLBENZENE	<0.001
NAPHTHALENE	<0.001
P-ISOPROPYLTOLUENE	<0.001
SEC-BUTYLBENZENE	<0.001
TERT-BUTYLBENZENE	<0.001

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	82-2	82-3	82-4	82-4	83-5	83-6	83-6	83-6
SAMPLE DATE	11/11/89	11/13/89	11/11/89	05/11/90	11/13/89	11/13/89	04/05/91	01/31/92
SAMPLE TIME	17:15	11:45	15:30	15:30	11:10	11:00	14:00	09:45
LAB	EL	HYDRO	EL	EL	HYDRO	HYDRO	EL	EL
LAB NUMBER	89-20181		89-20180	90-12199			91-12769	92-5001
SAMPLE NUMBER	HL-8911-002	HL-8911-904	HL-8911-001	HL-9005-122	HL-8911-901	HL-8911-900	HL-9104-106	HL-9201-111
-- PHYSICAL PARAMETERS --								
DEPTH TO WATER LVL (FT)	14.81	58.46	59.05		11.91	12.97	12.14	12.31
TOTAL DEPTH OF WELL (FT)	24.0	87.0	79.0				23.0	23.2
PH							7.5	7.8
SC (UMHOS/CM @25 C)								629.0
TDS (@ 180 C)							511.0	421.0
TOTAL SUSPENDED SOLIDS								420.0
WATER TEMPERATURE (FLD)								11.5
-- COMMON IONS --								
CALCIUM (CA) (DIS)							114.0	89.0
MAGNESIUM (MG) (DIS)							31.0	25.0
SODIUM (NA) (DIS)							23.0	20.0
POTASSIUM (K) (DIS)							5.0	3.0
TOTAL ALKALINITY AS CACO3							255.0	226.0
BICARBONATE (HCO3)							311.0	276.0
CARBONATE AS CO3							0.0	0.0
SULFATE (SO4)							109.0	86.0
CHLORIDE (CL)							32.0	26.0
-- NUTRIENTS --								
AMMONIA (NH3 AS N)								<0.1
NITRATE (NO3-N)								4.27
NITRATE + NITRITE AS N							8.91	
NITROGEN AS N							<0.1	
-- TRACE ELEMENTS --								
ARSENIC (AS) *DIS							<0.005	<0.005
BARIUM (BA) *DIS							<0.1	<0.1
CADMIUM (CD) *DIS							<0.001	<0.001
CHROMIUM (CR) *DIS							<0.02	<0.02
IRON (FE) *DIS							<0.03	0.09
LEAD (PB) *DIS							<0.01	<0.01
MANGANESE (MN) *DIS							0.04	0.05
MERCURY (HG) *DIS							<0.001	<0.001
SELENIUM (SE) *DIS							<0.005	<0.005
SILVER (AG) *DIS							<0.005	<0.005

* DIS - Dissolved

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	82-2	82-3	82-4	82-4	83-5	83-6	83-6	83-6
SAMPLE DATE	11/11/89	11/13/89	11/11/89	05/11/90	11/13/89	11/13/89	04/05/91	01/31/92
SAMPLE TIME	17:15	11:45	15:30	15:30	11:10	11:00	14:00	09:45
LAB	EL	HYDRO	EL	EL	HYDRO	HYDRO	EL	EL
LAB NUMBER	89-20181		89-20180	90-12199			91-12769	92-5001
SAMPLE NUMBER	HL-8911-002	HL-8911-904	HL-8911-001	HL-9005-122	HL-8911-901	HL-8911-900	HL-9104-106	HL-9201-111
-- VOLATILE ORGANICS --								
1,1,1,2-TETRACHLOROETHANE	<0.001		<0.001					
1,1,1-TRICHLOROETHANE	<0.0005		0.01				0.0029	0.0017
1,1,2,2-TETRACHLOROETHANE	<0.001		<0.001				<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001		<0.001				<0.001	<0.001
1,1-DICHLOROETHANE	<0.001		0.0028				<0.001	<0.001
1,1-DICHLOROETHENE	<0.0005		<0.0005				<0.0005	<0.0005
1,1-DICHLOROPROPENE	<0.001		<0.001					
1,2-DIBROMOETHANE	<0.001		<0.001					
1,2-DICHLOROETHANE	<0.0005		<0.0005				<0.0005	<0.0005
1,2-DICHLOROPROPANE	<0.001		<0.001					
2,2-DICHLOROPROPANE	<0.001		<0.001					
2-BUTANONE (METHYL-ETHYL-KETONE)							<0.01	
2-CHLOROETHYL VINYL ETHER							<0.01	<0.01
2-CHLOROTOLUENE	<0.001		<0.001					
2-HEXANONE							<0.01	
4-BROMOFLUOROBENZENE							0.01	<0.01
4-CHLOROTOLUENE	<0.001		<0.001					
4-METHYL-2-PENTANONE							<0.01	
ACETONE							<0.01	
ACROLEIN							<0.01	
ACRYLONITRILE							<0.01	
BENZENE	<0.0005		<0.0005				<0.0005	<0.0005
BROMOBENZENE	<0.001		<0.001					
BROMOCHLOROMETHANE	<0.001		<0.001				<0.001	<0.001
BROMODICHLOROMETHANE	<0.001		<0.001				<0.001	<0.001
BROMOFORM	<0.001		<0.001				<0.001	<0.001
BROMOMETHANE	<0.001		<0.001				<0.001	<0.001
CARBON DISULFIDE							<0.01	
CARBON TETRACHLORIDE	<0.0005		<0.0005				<0.0005	<0.0005
CHLOROBENZENE	<0.001		<0.001				<0.001	<0.001
CHLOROETHANE	<0.001		<0.001				<0.001	<0.001
CHLOROFORM	<0.001		<0.001				0.0032	0.003
CHLOROMETHANE	<0.001		<0.001				<0.001	<0.001
CIS-1,2-DICHLOROETHENE	<0.001		<0.001					
CIS-1,3-DICHLOROPROPENE	<0.001		<0.001				<0.001	<0.001
DIBROMOCHLOROMETHANE	<0.001		<0.001				<0.001	<0.001

* DIS - Dissolved

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	82-2	82-3	82-4	82-4	83-5	83-6	83-6	83-6
SAMPLE DATE	11/11/89	11/13/89	11/11/89	05/11/90	11/13/89	11/13/89	04/05/91	01/31/92
SAMPLE TIME	17:15	11:45	15:30	15:30	11:10	11:00	14:00	09:45
LAB	EL	HYDRO	EL	EL	HYDRO	HYDRO	EL	EL
LAB NUMBER	89-20181		89-20180	90-12199			91-12769	92-5001
SAMPLE NUMBER	HL-8911-002	HL-8911-904	HL-8911-001	HL-9005-122	HL-8911-901	HL-8911-900	HL-9104-106	HL-9201-111
— VOLATILE ORGANICS —								
DIBROMOMETHANE	<0.001		<0.001					
DICHLORODIFLUOROMETHANE	<0.001		0.069				<0.001	<0.001
ETHANOL							<0.001	<0.001
ETHYL METHACRYLATE							<0.01	
ETHYLBENZENE	<0.001		<0.001				<0.01	<0.01
IODOMETHANE							<0.001	<0.001
XYLENE							<0.01	<0.01
M-XYLENE	<0.001		<0.001				<0.001	<0.001
O-XYLENE	<0.001		<0.001					
P-XYLENE	<0.001		<0.001					
METHYLENE CHLORIDE	<0.001		0.0077					
STYRENE	<0.001		<0.001				<0.001	0.0036
TETRACHLOROETHENE	<0.0005		0.0049				<0.001	<0.001
TOLUENE	<0.001		<0.001				<0.0005	<0.0005
TRANS-1,2-DICHLOROETHENE	<0.001		<0.001				<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001		<0.001				<0.001	<0.001
TRICHLOROETHENE	<0.0005		0.0029				<0.001	<0.001
TRICHLOROFLUOROMETHANE	<0.001		0.042				<0.0005	<0.0005
VINYL ACETATE							<0.001	<0.001
VINYL CHLORIDE	<0.0005		<0.0005				<0.01	<0.01
							<0.0005	<0.0005
— SEMI-VOLATILE EXTRACTABLES —								
1,2,3-TRICHLOROBENZENE	<0.001		<0.001					
1,2,3-TRICHLOROPROPANE	<0.001		<0.001					
1,2,4-TRICHLOROBENZENE	<0.001		<0.001	<0.01			<0.001	<0.001
1,2,4-TRIMETHYLBENZENE	<0.001		<0.001					
1,2-DIBROMO-3-CHLOROPROPANE	<0.001		<0.001					
1,2-DICHLOROBENZENE	<0.001		<0.001	<0.01				
1,3,5-TRIMETHYLBENZENE	<0.001		<0.001					
1,3-DICHLOROBENZENE	<0.001		<0.001	<0.01				
1,3-DICHLOROPROPANE	<0.001		<0.001					
1,4-DICHLORO-2-BUTENE							<0.01	
1,4-DICHLOROBENZENE	<0.0005		<0.0005	<0.01				
1,4-DIFLUOROBENZENE							<0.01	<0.01
2-METHYL-4 6-DINITROPHENOL				<0.05				
2,4,6-TRICHLOROPHENOL				<0.01				

* DIS - Dissolved

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	82-2	82-3	82-4	82-4	83-5	83-6	83-6	83-6
SAMPLE DATE	11/11/89	11/13/89	11/11/89	05/11/90	11/13/89	11/13/89	04/05/91	01/31/92
SAMPLE TIME	17:15	11:45	15:30	15:30	11:10	11:00	14:00	09:45
LAB	EL	HYDRO	EL	EL	HYDRO	HYDRO	EL	EL
LAB NUMBER	89-20181		89-20180	90-12199			91-12769	92-5001
SAMPLE NUMBER	HL-8911-002	HL-8911-904	HL-8911-001	HL-9005-122	HL-8911-901	HL-8911-900	HL-9104-106	HL-9201-111
— SEMI-VOLATILE EXTRACTABLES —								
2,4-DICHLOROPHENOL				<0.01				
2,4-DIMETHYLPHENOL				<0.01				
2,4-DINITROPHENOL				<0.05				
2,4-DINITROTOLUENE				<0.01				
2,6-DINITROTOLUENE				<0.01				
2-CHLORONAPHTHALENE				<0.01				
2-CHLOROPHENOL				<0.01				
2-NITROPHENOL				<0.01				
3,3-DICHLOROBENZIDINE				<0.01				
4-BROMOPHENYL PHENYL ETHER				<0.01				
4-CHLORO-3-METHYLPHENOL				<0.01				
4-CHLOROPHENYL PHENYL ETHER				<0.01				
4-NITROPHENOL				<0.05				
ACENAPHTHENE				<0.01				
ACENAPHTHYLENE				<0.01				
ANTHRACENE				<0.01				
1,2-DIPHENYLHYDRAZINE (AZOBENZEN				<0.01				
BENZIDINE				<0.01				
BENZO (A) ANTHRACENE				<0.01				
BENZO (A) PYRENE				<0.01				
BENZO (B) FLUORANTHENE				<0.01				
BENZO (GHI) PERYLENE				<0.01				
BENZO (K) FLUORANTHENE				<0.01				
BIS (2-CHLOROETHOXY) METHANE				<0.01				
BIS (2-CHLOROETHYL) ETHER				<0.01				
BIS (2-CHLOROISOPROPYL) ETHER				<0.01				
BIS (2-ETHYLHEXYL) PHTHALATE				<0.01				
BUTYL BENZYL PHTHALATE				<0.01				
CHRYSENE				<0.01				
DI-N-BUTYLPHTHALATE				<0.01				
DI-N-OCTYLPHTHALATE				<0.01				
DIBENZO (A,H) ANTHRACENE				<0.01				
DICHLOROMONOFLUOROMETHANE			0.031					
DIETHYLPHTHALATE				<0.01				
DIMETHYLPHTHALATE				<0.01				
FLUORANTHENE				<0.01				

* DIS - Dissolved

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	82-2	82-3	82-4	82-4	83-5	83-6	83-6	83-6
SAMPLE DATE	11/11/89	11/13/89	11/11/89	05/11/90	11/13/89	11/13/89	04/05/91	01/31/92
SAMPLE TIME	17:15	11:45	15:30	15:30	11:10	11:00	14:00	09:45
LAB	EL	HYDRO	EL	EL	HYDRO	HYDRO	EL	EL
LAB NUMBER	89-20181		89-20180	90-12199			91-12769	92-5001
SAMPLE NUMBER	HL-8911-002	HL-8911-904	HL-8911-001	HL-9005-122	HL-8911-901	HL-8911-900	HL-9104-106	HL-9201-111
-- SEMI-VOLATILE EXTRACTABLES --								
FLUORENE				<0.01				
HEXACHLOROBENZENE				<0.01				
HEXACHLOROBUTADIENE	<0.001		<0.001	<0.01				
HEXACHLOROETHANE				<0.01				
INDENO (1,2,3-CD) PYRENE				<0.01				
ISOPHORONE				<0.01				
ISOPROPYLBENZENE	<0.001		<0.001					
N-BUTYLBENZENE	<0.001		<0.001					
N-NITROSO-DI-N-PROPYLAMINE				<0.01				
N-NITROSOPHENYLAMINE				<0.01				
N-PROPYLBENZENE	<0.001		<0.001					
NAPHTHALENE	<0.001		<0.001	<0.01				
NITROBENZENE				<0.01				
P-ISOPROPYLTOLUENE	<0.001		<0.001					
PENTACHLOROPHENOL				<0.05				
PHENANTHRENE				<0.01				
PHENOL				<0.01				
PYRENE				<0.01				
SEC-BUTYLBENZENE	<0.001		<0.001					
TERT-BUTYLBENZENE	<0.001		<0.001					
-- HYDROCARBONS --								
ORGANIC CARBON							<2.0	
-- OTHER PARAMETERS --								
CYANIDE (CN)							<0.005	
CYANIDE (CN) *TOT								<0.005
CHEMICAL OXYGEN DEMAND							<1.0	<1.0

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	83-6	83-7	EPA-1	EPA-1	EPA-1	FAIR GRND	HL-1	HL-1
SAMPLE DATE	05/19/92	11/11/89	04/05/91	01/22/92	05/20/92	06/05/90	11/13/89	05/06/90
SAMPLE TIME	16:30	18:35	12:00	09:45	13:30	10:45	11:30	11:25
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	92-19274	89-20183	91-12768	92-4687	92-19275	90-15039	89-20185	90-10827
SAMPLE NUMBER	HL-9205-103	HL-8911-004	HL-9104-105	HL-9201-103	HL-9205-123	HL-9006-101	HL-8911-006	HL-9005-110
-- PHYSICAL PARAMETERS --								
DEPTH TO WATER LVL (FT)	12.79	33.7	45.07	44.73	45.37		17.53	
TOTAL DEPTH OF WELL (FT)	23.0	40.0	54.5	59.0	59.0		20.0	
PH (FLD)	7.36							
PH	7.6							
SC (UMHOS/CM @25 C) (FLD)	680.0							
SC (UMHOS/CM @25 C)	667.0							
TDS (@ 180 C)	425.0							
TOTAL SUSPENDED SOLIDS	10.0							
WATER TEMPERATURE (FLD)	13.2			10.0				
-- COMMON IONS --								
CALCIUM (CA) (DIS)	94.0							
MAGNESIUM (MG) (DIS)	27.0							
SODIUM (NA) (DIS)	22.0							
POTASSIUM (K) (DIS)	4.0							
TOTAL ALKALINITY AS CACO3	256.0							
BICARBONATE (HCO3)	313.0							
CARBONATE AS CO3	0.0							
SULFATE (SO4)	89.0							
CHLORIDE (CL)	28.0							
-- NUTRIENTS --								
AMMONIA (NH3 AS N)	<0.1							
NITRATE (NO3-N)	4.02							
-- TRACE ELEMENTS --								
ARSENIC (AS) *DIS	<0.005							
BARIUM (BA) *DIS	<0.1							
CADMIUM (CD) *DIS	<0.001							
CHROMIUM (CR) *DIS	<0.01							
IRON (FE) *DIS	0.1							
LEAD (PB) *DIS	<0.01							
MANGANESE (MN) *DIS	<0.02							
MERCURY (HG) *DIS	<0.001							
SELENIUM (SE) *DIS	<0.005							

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	83-6	83-7	EPA-1	EPA-1	EPA-1	FAIR GRND	HL-1	HL-1
SAMPLE DATE	05/19/92	11/11/89	04/05/91	01/22/92	05/20/92	06/05/90	11/13/89	05/06/90
SAMPLE TIME	16:30	18:35	12:00	09:45	13:30	10:45	11:30	11:25
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	92-19274	89-20183	91-12768	92-4687	92-19275	90-15039	89-20185	90-10827
SAMPLE NUMBER	HL-9205-103	HL-8911-004	HL-9104-105	HL-9201-103	HL-9205-123	HL-9006-101	HL-8911-006	HL-9005-110
— TRACE ELEMENTS —								
SILVER (AG) *DIS	<0.005							
-- VOLATILE ORGANICS —								
1,1,1,2-TETRACHLOROETHANE		<0.001				<0.001	<0.001	<0.001
1,1,1-TRICHLOROETHANE	0.0014	<0.0005	<0.0005	0.00065	0.00074	<0.0005	<0.0005	<0.0005
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-DICHLOROETHANE	<0.001	<0.001	0.0038	0.0058	0.0049	<0.001	<0.001	<0.001
1,1-DICHLOROETHENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,1-DICHLOROPROPENE		<0.001				<0.001	<0.001	<0.001
1,2-DIBROMOETHANE		<0.001				<0.001	<0.001	<0.001
1,2-DICHLOROETHANE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00005	<0.0005
1,2-DICHLOROETHENE						<0.0005		
1,2-DICHLOROPROPANE		<0.001				<0.001	<0.001	<0.001
2,2-DICHLOROPROPANE		<0.001				<0.001	<0.001	<0.001
2-BUTANONE (METHYL-ETHYL-KETONE)			<0.01					
2-CHLOROETHYL VINYL ETHER	<0.01		<0.01	<0.01	<0.01			
2-CHLOROTOLUENE		<0.001				<0.001	<0.001	<0.001
2-HEXANONE			<0.01					
4-BROMOFLUOROBENZENE	<0.01		<0.01	<0.01	<0.01			
4-CHLOROTOLUENE		<0.001				<0.001	<0.001	<0.001
4-METHYL-2-PENTANONE			<0.01					
ACETONE			<0.01					
ACROLEIN			<0.01					
ACRYLONITRILE			<0.01					
BENZENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BROMOBENZENE		<0.001				<0.001	<0.001	<0.001
BROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	0.0053	<0.001	<0.001
BROMOFORM	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CARBON DISULFIDE			<0.01					
CARBON TETRACHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
CHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	83-6	83-7	EPA-1	EPA-1	EPA-1	FAIR GRND	HL-1	HL-1
SAMPLE DATE	05/19/92	11/11/89	04/05/91	01/22/92	05/20/92	06/05/90	11/13/89	05/06/90
SAMPLE TIME	16:30	18:35	12:00	09:45	13:30	10:45	11:30	11:25
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	92-19274	89-20183	91-12768	92-4687	92-19275	90-15039	89-20185	90-10827
SAMPLE NUMBER	HL-9205-103	HL-8911-004	HL-9104-105	HL-9201-103	HL-9205-123	HL-9006-101	HL-8911-006	HL-9005-110
-- VOLATILE ORGANICS --								
CHLOROFORM	0.0012	<0.001	0.007	0.015	0.016	0.088	0.0035	0.0079
CHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CIS-1,2-DICHLOROETHENE		0.0044				<0.001	<0.001	<0.001
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DICHLORODIFLUOROMETHANE	<0.001	<0.001	0.011	0.007	0.016	<0.001	<0.001	<0.001
ETHANOL			<0.01					
ETHYL METHACRYLATE	<0.01		<0.01	<0.01	<0.01			
ETHYLBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
IODOMETHANE	<0.01		<0.01	<0.01	<0.01			
XYLENE	<0.001		<0.001	<0.001	<0.001			
M-XYLENE		<0.001				<0.001	<0.001	<0.001
O-XYLENE		<0.001				<0.001	<0.001	<0.001
P-XYLENE		<0.001				<0.001	<0.001	<0.001
METHYLENE CHLORIDE	<0.001	<0.001	0.0042	0.0034	0.0012	<0.001	<0.001	<0.001
STYRENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TETRACHLOROETHENE	<0.0005	<0.0005	0.066	0.081	0.079	<0.0005	<0.0005	0.00083
TOLUENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRICHLOROETHENE	<0.0005	<0.0005	0.0074	0.0054	0.0059	<0.0005	<0.0005	<0.0005
TRICHLOROFLUOROMETHANE	<0.001	<0.001	0.0043	0.0078	0.0083	<0.001	<0.001	<0.001
VINYL ACETATE	<0.01		<0.01	<0.01	<0.01			
VINYL CHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
-- SEMI-VOLATILE EXTRACTABLES --								
1,2,3-TRICHLOROBENZENE		<0.001				<0.001	<0.001	<0.001
1,2,3-TRICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRICHLOROBENZENE		<0.001				<0.001	<0.001	<0.001
1,2,4-TRIMETHYLBENZENE		<0.001				<0.001	<0.001	<0.001
1,2-DIBROMO-3-CHLOROPROPANE		<0.001				<0.001	<0.001	<0.001
1,2-DICHLOROBENZENE		<0.001				<0.001	<0.001	<0.001
1,3,5-TRIMETHYLBENZENE		<0.001				<0.001	<0.001	<0.001
1,3-DICHLOROBENZENE		<0.001				<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	83-6	83-7	EPA-1	EPA-1	EPA-1	FAIR GRND	HL-1	HL-1
SAMPLE DATE	05/19/92	11/11/89	04/05/91	01/22/92	05/20/92	06/05/90	11/13/89	05/06/90
SAMPLE TIME	16:30	18:35	12:00	09:45	13:30	10:45	11:30	11:25
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	92-19274	89-20183	91-12768	92-4687	92-19275	90-15039	89-20185	90-10827
SAMPLE NUMBER	HL-9205-103	HL-8911-004	HL-9104-105	HL-9201-103	HL-9205-123	HL-9006-101	HL-8911-006	HL-9005-110
— SEMI-VOLATILE EXTRACTABLES —								
1,3-DICHLOROPROPANE		<0.001				<0.001	<0.001	<0.001
1,4-DICHLORO-2-BUTENE			<0.01					
1,4-DICHLOROBENZENE		<0.0005				<0.0005	<0.0005	<0.0005
1,4-DIFLUOROBENZENE	<0.01		<0.01	<0.01	<0.01			
DICHLOROMONOFLUOROMETHANE		<0.001				<0.001		<0.001
HEXACHLOROBUTADIENE		<0.001				<0.001	<0.001	<0.001
ISOPROPYLBENZENE		<0.001				<0.001	<0.001	<0.001
N-BUTYLBENZENE		<0.001				<0.001	<0.001	<0.001
N-PROPYLBENZENE		<0.001				<0.001	<0.001	<0.001
NAPHTHALENE		<0.001				<0.001	<0.001	<0.001
P-ISOPROPYLTOLUENE		<0.001				<0.001	<0.001	<0.001
SEC-BUTYLBENZENE		<0.001				<0.001	<0.001	<0.001
TERT-BUTYLBENZENE		<0.001				<0.001	<0.001	<0.001
— OTHER PARAMETERS —								
CYANIDE (CN) *TOT	<0.005							
CHEMICAL OXYGEN DEMAND	<1.0							

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	HL-2	HL-3	HL-5	HL-5	HL-6	HL-7	HL-90-1
SAMPLE DATE	11/13/89	11/13/89	11/13/89	05/06/90	05/06/90	11/11/89	02/02/90
SAMPLE TIME	11:20	11:50	11:40	11:45	12:00	17:55	16:15
LAB	HYDRO	HYDRO	HYDRO	EL	EL	EL	EL
LAB NUMBER				90-10829	90-10830	89-20182	90-2766
SAMPLE NUMBER	HL-8911-902	HL-8911-903	HL-8911-905	HL-9005-112	HL-9005-113	HL-8911-003	HL90-2-101
— PHYSICAL PARAMETERS —							
DEPTH TO WATER LVL (FT)	27.17	DRY	29.31			10.41	49.19
TOTAL DEPTH OF WELL (FT)	30.0		31.44			18.0	68.0
PH							7.8
SC (UMHOS/CM @25 C)							1100.0
TDS (@ 180 C)							685.0
— COMMON IONS —							
TOTAL HARDNESS AS CACO3							528.0
CALCIUM (CA) (DIS)							137.0
MAGNESIUM (MG) (DIS)							45.0
SODIUM (NA) (DIS)							35.0
POTASSIUM (K) (DIS)							3.0
TOTAL ALKALINITY AS CACO3							395.0
BICARBONATE (HCO3)							482.0
CARBONATE AS CO3							0.0
SULFATE (SO4)							132.0
CHLORIDE (CL)							31.0
— NUTRIENTS —							
NITRATE + NITRITE AS N							8.4
— TRACE ELEMENTS —							
CADMIUM (CD) *DIS							0.005
COPPER (CU) *DIS							<0.01
IRON (FE) *DIS							<0.03
LEAD (PB) *DIS							<0.01
ZINC (ZN) *DIS							0.02
— VOLATILE ORGANICS —							
1,1,1,2-TETRACHLOROETHANE				<0.001	<0.001	<0.001	<0.001
1,1,1-TRICHLOROETHANE				<0.0005	<0.0005	0.0071	0.0074
1,1,2,2-TETRACHLOROETHANE				<0.001	<0.001	<0.001	<0.001
1,1,2-TRICHLOROETHANE				<0.001	<0.001	<0.001	<0.001
1,1-DICHLOROETHANE				<0.001	<0.001	0.0058	0.0026

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	HL-2	HL-3	HL-5	HL-5	HL-6	HL-7	HL-90-1
SAMPLE DATE	11/13/89	11/13/89	11/13/89	05/06/90	05/06/90	11/11/89	02/02/90
SAMPLE TIME	11:20	11:50	11:40	11:45	12:00	17:55	16:15
LAB	HYDRO	HYDRO	HYDRO	EL	EL	EL	EL
LAB NUMBER				90-10829	90-10830	89-20182	90-2766
SAMPLE NUMBER	HL-8911-902	HL-8911-903	HL-8911-905	HL-9005-112	HL-9005-113	HL-8911-003	HL90-2-101
-- VOLATILE ORGANICS --							
1,1-DICHLOROETHENE				<0.0005	<0.0005	<0.0005	<0.0005
1,1-DICHLOROPROPENE				<0.001	<0.001	<0.001	<0.001
1,2-DIBROMOETHANE				<0.001	<0.001	<0.001	<0.001
1,2-DICHLOROETHANE				<0.0005	<0.0005	<0.0005	0.00058
1,2-DICHLOROPROPANE				<0.001	<0.001	<0.001	<0.001
2,2-DICHLOROPROPANE				<0.001	<0.001	<0.001	<0.001
2-CHLOROTOLUENE				<0.001	<0.001	<0.001	<0.001
4-CHLOROTOLUENE				<0.001	<0.001	<0.001	<0.001
BENZENE				<0.0005	<0.0005	<0.0005	<0.0005
BROMOBENZENE				<0.001	<0.001	<0.001	<0.001
BROMOCHLOROMETHANE				<0.001	<0.001	<0.001	<0.001
BROMODICHLOROMETHANE				<0.001	<0.001	<0.001	<0.001
BROMOFORM				<0.001	<0.001	<0.001	<0.001
BROMOMETHANE				<0.001	<0.001	<0.001	<0.001
CARBON TETRACHLORIDE				<0.0005	<0.0005	<0.0005	<0.0005
CHLOROBENZENE				<0.001	<0.001	<0.001	<0.001
CHLOROETHANE				<0.001	<0.001	<0.001	<0.001
CHLOROFORM				0.0023	0.002	0.0023	0.0035
CHLOROMETHANE				<0.001	<0.001	<0.001	<0.001
CIS-1,2-DICHLOROETHENE				<0.001	<0.001	<0.001	<0.001
CIS-1,3-DICHLOROPROPENE				<0.001	<0.001	<0.001	<0.001
DIBROMOCHLOROMETHANE				<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE				<0.001	<0.001	<0.001	<0.001
DICHLORODIFLUOROMETHANE				0.001	<0.001	0.016	0.015
ETHYLBENZENE				<0.001	<0.001	<0.001	<0.001
M-XYLENE				<0.001	<0.001	<0.001	<0.001
O-XYLENE				<0.001	<0.001	<0.001	<0.001
P-XYLENE				<0.001	<0.001	<0.001	<0.001
METHYLENE CHLORIDE				<0.001	<0.001	0.0017	0.0036
STYRENE				<0.001	<0.001	<0.001	<0.001
TETRACHLOROETHENE				<0.0005	<0.0005	0.0045	0.013
TOLUENE				<0.001	<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE				<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE				<0.001	<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	HL-2	HL-3	HL-5	HL-5	HL-6	HL-7	HL-90-1
SAMPLE DATE	11/13/89	11/13/89	11/13/89	05/06/90	05/06/90	11/11/89	02/02/90
SAMPLE TIME	11:20	11:50	11:40	11:45	12:00	17:55	16:15
LAB	HYDRO	HYDRO	HYDRO	EL	EL	EL	EL
LAB NUMBER				90-10829	90-10830	89-20182	90-2766
SAMPLE NUMBER	HL-8911-902	HL-8911-903	HL-8911-905	HL-9005-112	HL-9005-113	HL-8911-003	HL90-2-101
-- VOLATILE ORGANICS --							
TRICHLOROETHENE				<0.0005	<0.0005	0.0035	0.0015
TRICHLOROFLUOROMETHANE				<0.001	<0.001	<0.001	<0.001
VINYL CHLORIDE				<0.0005	<0.0005	<0.0005	<0.0005
-- SEMI-VOLATILE EXTRACTABLES --							
1,2,3-TRICHLOROBENZENE				<0.001	<0.001	<0.001	<0.001
1,2,3-TRICHLOROPROPANE				<0.001	<0.001	<0.001	<0.001
1,2,4-TRICHLOROBENZENE				<0.001	<0.001	<0.001	<0.001
1,2,4-TRIMETHYLBENZENE				<0.001	<0.001	<0.001	<0.001
1,2-DIBROMO-3-CHLOROPROPANE				<0.001	<0.001	<0.001	<0.001
1,2-DICHLOROBENZENE				<0.001	<0.001	<0.001	<0.001
1,3,5-TRIMETHYLBENZENE				<0.001	<0.001	<0.001	<0.001
1,3-DICHLOROBENZENE				<0.001	<0.001	<0.001	<0.001
1,3-DICHLOROPROPANE				<0.001	<0.001	<0.001	<0.001
1,4-DICHLOROBENZENE				<0.0005	<0.0005	<0.0005	<0.0005
DICHLOROMONOFLUOROMETHANE				<0.001	<0.001	0.0063	0.0069
HEXACHLOROBUTADIENE				<0.001	<0.001	<0.001	<0.001
ISOPROPYLBENZENE				<0.001	<0.001	<0.001	<0.001
N-BUTYLBENZENE				<0.001	<0.001	<0.001	<0.001
N-PROPYLBENZENE				<0.001	<0.001	<0.001	<0.001
NAPHTHALENE				<0.001	<0.001	<0.001	<0.001
P-ISOPROPYLTOLUENE				<0.001	<0.001	<0.001	<0.001
SEC-BUTYLBENZENE				<0.001	<0.001	<0.001	<0.001
TERT-BUTYLBENZENE				<0.001	<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	HL-90-1	HL-90-1	HL-90-1	HL-90-1	HL-90-1	HL-90-2	HL-90-2	HL-90-2	HL-90-2	HL-90-2	HL-90-2
SAMPLE DATE	05/11/90	04/05/91	04/05/91	01/21/92	05/19/92	02/03/90	05/10/90	04/04/91	01/22/92	05/19/92	05/19/92
SAMPLE TIME	11:10	15:30	16:00	15:00	12:40	12:45	16:40	16:00	11:30	15:00	15:30
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-12198	91-12771	91-12772	92-4684	92-19270	90-2767	90-12197	91-12767	92-4686	92-19272	92-19273
REMARKS			Duplicate								DUPLICATE
SAMPLE NUMBER	HL-9005-121	HL-9104-108	HL-9104-118	HL-9201-101	HL-9205-122	HL90-2-102	HL-9005-120	HL-9104-104	HL-9201-104	HL-9205-101	HL-9205-119
— PHYSICAL PARAMETERS —											
DEPTH TO WATER LVL (FT)		51.25	51.25	52.23	54.58	46.15		47.55	56.55	50.15	50.15
TOTAL DEPTH OF WELL (FT)		60.0	60.0	60.0	60.0	68.0		68.0	68:0	68.0	68.0
PH (FLD)					7.49					7.7	7.7
PH		7.7	7.6	7.6	7.9	7.9		7.8	7.8	8.1	8.0
SC (UMHOS/CM @25 C) (FLD)					1017.0					830.0	830.0
SC (UMHOS/CM @25 C)				1050.0	1030.0	877.0			815.0	841.0	826.0
TDS (@ 180 C)		687.0	678.0	674.0	636.0	511.0		489.0	467.0	496.0	491.0
TOTAL SUSPENDED SOLIDS				146.0	4.0				146.0	4.0	4.0
WATER TEMPERATURE (FLD)				10.0	13.3				9.0	11.3	11.3
— COMMON IONS —											
TOTAL HARDNESS AS CACO3						444.0					
CALCIUM (CA) (DIS)		144.0	145.0	143.0	113.0	121.0		116.0	110.0	102.0	101.0
MAGNESIUM (MG) (DIS)		48.0	48.0	50.0	51.0	35.0		33.0	36.0	36.0	37.0
SODIUM (NA) (DIS)		38.0	37.0	42.0	41.0	23.0		25.0	28.0	27.0	28.0
POTASSIUM (K) (DIS)		5.0	4.0	6.0	3.0	3.0		3.0	5.0	4.0	3.0
TOTAL ALKALINITY AS CACO3		402.0	399.0	421.0	396.0	367.0		351.0	350.0	364.0	357.0
BICARBONATE (HCO3)		491.0	487.0	514.0	483.0	448.0		428.0	427.0	444.0	436.0
CARBONATE AS CO3		0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
SULFATE (SO4)		140.0	141.0	139.0	165.0	62.0		61.0	60.0	75.0	76.0
CHLORIDE (CL)		33.0	33.0	33.0	33.0	32.0		31.0	36.0	31.0	31.0
-- NUTRIENTS --											
AMMONIA (NH3 AS N)		<0.1		<0.1	<0.1			<0.1	<0.1	<0.1	<0.1
NITRATE (NO3-N)					6.86					1.0	1.01
NITRATE + NITRITE AS N		7.53		5.7		0.9		0.83	0.96		
— TRACE ELEMENTS —											
ARSENIC (AS) *DIS		<0.005		<0.005	<0.005			<0.005	<0.005	<0.005	<0.005
BARIUM (BA) *DIS		<0.1		<0.1	<0.1			<0.1	<0.1	<0.1	<0.1
CADMIUM (CD) *DIS		0.001		<0.001	<0.001	0.005		0.001	<0.001	<0.001	<0.001
CHROMIUM (CR) *DIS		<0.02		<0.02	<0.01			<0.02	<0.02	<0.01	<0.01
COPPER (CU) *DIS						<0.01					
IRON (FE) *DIS		<0.03		<0.03	<0.03	0.06		0.12	0.07	0.11	0.11

* DIS - Dissolved
* TOT - Total

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Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	HL-90-1	HL-90-1	HL-90-1	HL-90-1	HL-90-1	HL-90-2	HL-90-2	HL-90-2	HL-90-2	HL-90-2	HL-90-2
SAMPLE DATE	05/11/90	04/05/91	04/05/91	01/21/92	05/19/92	02/03/90	05/10/90	04/04/91	01/22/92	05/19/92	05/19/92
SAMPLE TIME	11:10	15:30	16:00	15:00	12:40	12:45	16:40	16:00	11:30	15:00	15:30
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-12198	91-12771	91-12772	92-4684	92-19270	90-2767	90-12197	91-12767	92-4686	92-19272	92-19273
REMARKS			Duplicate								DUPLICATE
SAMPLE NUMBER	HL-9005-121	HL-9104-108	HL-9104-118	HL-9201-101	HL-9205-122	HL90-2-102	HL-9005-120	HL-9104-104	HL-9201-104	HL-9205-101	HL-9205-119
— TRACE ELEMENTS —											
LEAD (PB) *DIS		<0.01		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01
MANGANESE (MN) *DIS		<0.02		<0.02	<0.02			<0.02	<0.02	<0.02	<0.02
MERCURY (HG) *DIS		<0.001		<0.001	<0.001			<0.001	<0.001	<0.001	<0.001
SELENIUM (SE) *DIS		<0.005		<0.005	<0.005			<0.005	<0.005	<0.005	<0.005
SILVER (AG) *DIS		<0.005		<0.005	<0.005			<0.005	<0.005	<0.005	<0.005
ZINC (ZN) *DIS						0.02					
— VOLATILE ORGANICS —											
1,1,1,2-TETRACHLOROETHANE						<0.001					
1,1,1-TRICHLOROETHANE		0.007	0.0066	0.0056	0.0051	0.002		0.001	0.00078	0.00099	0.00089
1,1,2,2-TETRACHLOROETHANE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
1,1,2-TRICHLOROETHANE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
1,1-DICHLOROETHANE		0.0029	0.0028	0.0032	0.0025	0.0029		0.0022	0.0021	0.0022	0.002
1,1-DICHLOROETHENE		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005
1,1-DICHLOROPROPENE						<0.001					
1,2-DIBROMOETHANE						<0.001					
1,2-DICHLOROETHANE		0.0005	0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005
1,2-DICHLOROPROPANE						<0.001					
2,2-DICHLOROPROPANE						<0.001					
2-BUTANONE (METHYL-ETHYL-KETONE)		<0.01	<0.01					<0.01			
2-CHLOROETHYL VINYL ETHER		<0.01	<0.01	<0.01	<0.01			<0.01	<0.01	<0.01	<0.01
2-CHLOROTOLUENE						<0.001					
2-HEXANONE		<0.01	<0.01					<0.01			
4-BROMOFLUOROBENZENE		<0.01	<0.01	<0.01	<0.01			<0.01	<0.01	<0.01	<0.01
4-CHLOROTOLUENE						<0.001					
4-METHYL-2-PENTANONE		<0.01	<0.01					<0.01			
ACETONE		<0.01	<0.01					<0.01			
ACROLEIN		<0.01	<0.01					<0.01			
ACRYLONITRILE		<0.01	<0.01					<0.01			
BENZENE		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005
BROMOBENZENE						<0.001					
BROMOCHLOROMETHANE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
BROMODICHLOROMETHANE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
BROMOFORM		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	HL-90-1	HL-90-1	HL-90-1	HL-90-1	HL-90-1	HL-90-2	HL-90-2	HL-90-2	HL-90-2	HL-90-2	HL-90-2
SAMPLE DATE	05/11/90	04/05/91	04/05/91	01/21/92	05/19/92	02/03/90	05/10/90	04/04/91	01/22/92	05/19/92	05/19/92
SAMPLE TIME	11:10	15:30	16:00	15:00	12:40	12:45	16:40	16:00	11:30	15:00	15:30
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-12198	91-12771	91-12772	92-4684	92-19270	90-2767	90-12197	91-12767	92-4686	92-19272	92-19273
REMARKS			Duplicate								DUPLICATE
SAMPLE NUMBER	HL-9005-121	HL-9104-108	HL-9104-118	HL-9201-101	HL-9205-122	HL90-2-102	HL-9005-120	HL-9104-104	HL-9201-104	HL-9205-101	HL-9205-119
-- VOLATILE ORGANICS --											
BROMOMETHANE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
CARBON DISULFIDE		<0.01	<0.01					<0.01			
CARBON TETRACHLORIDE		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005
CHLOROBENZENE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
CHLOROETHANE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
CHLOROFORM		0.0041	0.0039	0.0043	0.0038	<0.001		<0.001	<0.001	<0.001	<0.001
CHLOROMETHANE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
CIS-1,2-DICHLOROETHENE						<0.001					
CIS-1,3-DICHLOROPROPENE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
DIBROMOCHLOROMETHANE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
DICHLORODIFLUOROMETHANE		0.0089	0.0088	0.0054	0.0091	0.0056		<0.001	<0.001	0.0018	0.0017
ETHANOL		<0.01	<0.01					<0.01			
ETHYL METHACRYLATE		<0.01	<0.01	<0.01	<0.01			<0.01	<0.01	<0.01	<0.01
ETHYLBENZENE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
IODOMETHANE		<0.01	<0.01	<0.01	<0.01			<0.01	<0.01	<0.01	<0.01
XYLENE		<0.001	<0.001	<0.001	<0.001			<0.001	<0.001	<0.001	<0.001
M-XYLENE						<0.001					
O-XYLENE						<0.001					
P-XYLENE						<0.001					
METHYLENE CHLORIDE		0.0036	0.0035	0.005	0.0029	<0.001		<0.001	<0.001	<0.001	<0.001
STYRENE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
TETRACHLOROETHENE		0.012	0.013	0.016	0.014	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005
TOLUENE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001
TRICHLOROETHENE		0.0022	0.0022	0.0022	0.0021	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005
TRICHLOROFLUOROMETHANE		0.0028	0.0026	0.0031	0.002	<0.001		<0.001	<0.001	<0.001	<0.001
VINYL ACETATE		<0.01	<0.01	<0.01	<0.01			<0.01	<0.01	<0.01	<0.01
VINYL CHLORIDE		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005
-- SEMI-VOLATILE EXTRACTABLES --											
1,2,3-TRICHLOROBENZENE						<0.001					
1,2,3-TRICHLOROPROPANE		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	HL-90-1	HL-90-1	HL-90-1	HL-90-1	HL-90-1	HL-90-2	HL-90-2	HL-90-2	HL-90-2	HL-90-2	HL-90-2
SAMPLE DATE	05/11/90	04/05/91	04/05/91	01/21/92	05/19/92	02/03/90	05/10/90	04/04/91	01/22/92	05/19/92	05/19/92
SAMPLE TIME	11:10	15:30	16:00	15:00	12:40	12:45	16:40	16:00	11:30	15:00	15:30
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-12198	91-12771	91-12772	92-4684	92-19270	90-2767	90-12197	91-12767	92-4686	92-19272	92-19273
REMARKS			Duplicate								DUPLICATE
SAMPLE NUMBER	HL-9005-121	HL-9104-108	HL-9104-118	HL-9201-101	HL-9205-122	HL90-2-102	HL-9005-120	HL-9104-104	HL-9201-104	HL-9205-101	HL-9205-119
-- SEMI-VOLATILE EXTRACTABLES --											
1,2,4-TRICHLOROBENZENE	<0.01					<0.001	<0.01				
1,2,4-TRIMETHYLBENZENE						<0.001					
1,2-DIBROMO-3-CHLOROPROPANE						<0.001					
1,2-DICHLOROBENZENE	<0.01					<0.001	<0.01				
1,3,5-TRIMETHYLBENZENE						<0.001					
1,3-DICHLOROBENZENE	<0.01					<0.001	<0.01				
1,3-DICHLOROPROPANE						<0.001					
1,4-DICHLORO-2-BUTENE		<0.01	<0.01					<0.01			
1,4-DICHLOROBENZENE	<0.01					<0.0005	<0.01				
1,4-DIFLUOROBENZENE		<0.01	<0.01	<0.01	<0.01			<0.01	<0.01	<0.01	<0.01
2-METHYL-4 6-DINITROPHENOL	<0.05						<0.05				
2,4,6-TRICHLOROPHENOL	<0.01						<0.01				
2,4-DICHLOROPHENOL	<0.01						<0.01				
2,4-DIMETHYLPHENOL	<0.01						<0.01				
2,4-DINITROPHENOL	<0.05						<0.05				
2,4-DINITROTOLUENE	<0.01						<0.01				
2,6-DINITROTOLUENE	<0.01						<0.01				
2-CHLORONAPHTHALENE	<0.01						<0.01				
2-CHLOROPHENOL	<0.01						<0.01				
2-NITROPHENOL	<0.01						<0.01				
3,3-DICHLOROBENZIDINE	<0.01						<0.01				
4-BROMOPHENYL PHENYL ETHER	<0.01						<0.01				
4-CHLORO-3-METHYLPHENOL	<0.01						<0.01				
4-CHLOROPHENYL PHENYL ETHER	<0.01						<0.01				
4-NITROPHENOL	<0.05						<0.05				
ACENAPHTHENE	<0.01						<0.01				
ACENAPHTHYLENE	<0.01						<0.01				
ANTHRACENE	<0.01						<0.01				
1,2-DIPHENYLHYDRAZINE (AZOBENZEN	<0.01						<0.01				
BENZIDINE	<0.01						<0.01				
BENZO (A) ANTHRACENE	<0.01						<0.01				
BENZO (A) PYRENE	<0.01						<0.01				
BENZO (B) FLUORANTHENE	<0.01						<0.01				
BENZO (GHI) PERYLENE	<0.01						<0.01				

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	HL-90-1	HL-90-1	HL-90-1	HL-90-1	HL-90-1	HL-90-2	HL-90-2	HL-90-2	HL-90-2	HL-90-2	HL-90-2
SAMPLE DATE	05/11/90	04/05/91	04/05/91	01/21/92	05/19/92	02/03/90	05/10/90	04/04/91	01/22/92	05/19/92	05/19/92
SAMPLE TIME	11:10	15:30	16:00	15:00	12:40	12:45	16:40	16:00	11:30	15:00	15:30
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-12198	91-12771	91-12772	92-4684	92-19270	90-2767	90-12197	91-12767	92-4686	92-19272	92-19273
REMARKS			Duplicate								DUPLICATE
SAMPLE NUMBER	HL-9005-121	HL-9104-108	HL-9104-118	HL-9201-101	HL-9205-122	HL90-2-102	HL-9005-120	HL-9104-104	HL-9201-104	HL-9205-101	HL-9205-119
— SEMI-VOLATILE EXTRACTABLES —											
BENZO (K) FLUORANTHENE	<0.01						<0.01				
BIS (2-CHLOROETHOXY) METHANE	<0.01						<0.01				
BIS (2-CHLOROETHYL) ETHER	<0.01						<0.01				
BIS (2-CHLOROISOPROPYL) ETHER	<0.01						<0.01				
BIS (2-ETHYLHEXYL) PHTHALATE	<0.01						<0.01				
BUTYL BENZYL PHTHALATE	<0.01						<0.01				
CHRYSENE	<0.01						<0.01				
DI-N-BUTYLPHTHALATE	<0.01						<0.01				
DI-N-OCTYLPHTHALATE	<0.01						<0.01				
DIBENZO (A,H) ANTHRACENE	<0.01						<0.01				
DICHLOROMONOFLUOROMETHANE						0.0034					
DIETHYLPHTHALATE	<0.01						<0.01				
DIMETHYLPHTHALATE	<0.01						<0.01				
FLUORANTHENE	<0.01						<0.01				
FLUORENE	<0.01						<0.01				
HEXACHLOROBENZENE	<0.01						<0.01				
HEXACHLOROBUTADIENE	<0.01					<0.001	<0.01				
HEXACHLOROETHANE	<0.01						<0.01				
INDENO (1,2,3-CD) PYRENE	<0.01						<0.01				
ISOPHORONE	<0.01						<0.01				
ISOPROPYLBENZENE						<0.001					
N-BUTYLBENZENE						<0.001					
N-NITROSO-DI-N-PROPYLAMINE	<0.01						<0.01				
N-NITROSOPHENYLAMINE	<0.01						<0.01				
N-PROPYLBENZENE						<0.001					
NAPHTHALENE	<0.01					<0.001	<0.01				
NITROBENZENE	<0.01						<0.01				
P-ISOPROPYLTOLUENE						<0.001					
PENTACHLOROPHENOL	<0.05						<0.05				
PHENANTHRENE	<0.01						<0.01				
PHENOL	<0.01						<0.01				
PYRENE	<0.01						<0.01				
SEC-BUTYLBENZENE						<0.001					
TERT-BUTYLBENZENE						<0.001					

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	HL-90-1	HL-90-1	HL-90-1	HL-90-1	HL-90-1	HL-90-2	HL-90-2	HL-90-2	HL-90-2	HL-90-2	HL-90-2
SAMPLE DATE	05/11/90	04/05/91	04/05/91	01/21/92	05/19/92	02/03/90	05/10/90	04/04/91	01/22/92	05/19/92	05/19/92
SAMPLE TIME	11:10	15:30	16:00	15:00	12:40	12:45	16:40	16:00	11:30	15:00	15:30
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-12198	91-12771	91-12772	92-4684	92-19270	90-2767	90-12197	91-12767	92-4686	92-19272	92-19273
REMARKS			Duplicate								DUPLICATE
SAMPLE NUMBER	HL-9005-121	HL-9104-108	HL-9104-118	HL-9201-101	HL-9205-122	HL90-2-102	HL-9005-120	HL-9104-104	HL-9201-104	HL-9205-101	HL-9205-119
— HYDROCARBONS —											
ORGANIC CARBON		<2.0						2.0			
— OTHER PARAMETERS —											
CYANIDE (CN)		<0.005						<0.005			
CYANIDE (CN) *TOT				<0.005	<0.005				<0.005	<0.005	<0.005
CHEMICAL OXYGEN DEMAND		2.0		4.0	5.0			<1.0	2.0	1.0	2.0

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	HL-90-3	HL-90-3	HL-90-3	HL-90-3
SAMPLE DATE	02/02/90	04/05/91	01/21/92	05/19/92
SAMPLE TIME	14:30	14:30	14:00	10:30
LAB	EL	EL	EL	EL
LAB NUMBER	90-2765	91-12770	92-4683	92-19269
SAMPLE NUMBER	HL-90-2-100	HL-9104-107	HL-9201-100	HL-9205-109
— PHYSICAL PARAMETERS —				
DEPTH TO WATER LVL (FT)	57.81	55.47	54.16	56.71
TOTAL DEPTH OF WELL (FT)	79.0	79.0	79.0	79.0
PH (FLD)				7.08
PH	7.5	7.7	7.5	7.9
SC (UMHOS/CM @25 C) (FLD)				1000.0
SC (UMHOS/CM @25 C)	1130.0		963.0	1040.0
TDS (@ 180 C)	686.0	662.0	642.0	626.0
TOTAL SUSPENDED SOLIDS			1850.0	83.0
WATER TEMPERATURE (FLD)			10.0	12.4
— COMMON IONS —				
TOTAL HARDNESS AS CACO3	435.0			
CALCIUM (CA) (DIS)	109.0	108.0	95.0	93.0
MAGNESIUM (MG) (DIS)	40.0	39.0	35.0	41.0
SODIUM (NA) (DIS)	80.0	83.0	90.0	94.0
POTASSIUM (K) (DIS)	3.0	4.0	4.0	2.0
TOTAL ALKALINITY AS CACO3	400.0	393.0	399.0	405.0
BICARBONATE (HCO3)	488.0	479.0	487.0	494.0
CARBONATE AS CO3	0.0	0.0	0.0	0.0
SULFATE (SO4)	136.0	134.0	123.0	156.0
CHLORIDE (CL)	30.0	29.0	24.0	28.0
— NUTRIENTS —				
AMMONIA (NH3 AS N)			<0.1	<0.1
NITRATE + NITRITE AS N	5.7	6.91	6.3	
NITROGEN AS N		<0.1		7.07
— TRACE ELEMENTS —				
ARSENIC (AS) *DIS		<0.005	<0.005	<0.005
BARIUM (BA) *DIS		<0.1	<0.1	<0.1
CADMIUM (CD) *DIS	0.006	0.002	0.001	<0.001
CHROMIUM (CR) *DIS		<0.02	<0.02	<0.01
COPPER (CU) *DIS	<0.01			
IRON (FE) *DIS	<0.03	<0.03	<0.03	<0.03
LEAD (PB) *DIS	<0.01	<0.01	<0.01	<0.01

* DIS - Dissolved
* TOT - Total

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Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	HL-90-3	HL-90-3	HL-90-3	HL-90-3
SAMPLE DATE	02/02/90	04/05/91	01/21/92	05/19/92
SAMPLE TIME	14:30	14:30	14:00	10:30
LAB	EL	EL	EL	EL
LAB NUMBER	90-2765	91-12770	92-4683	92-19269
SAMPLE NUMBER	HL-90-2-100	HL-9104-107	HL-9201-100	HL-9205-109
-- TRACE ELEMENTS --				
MANGANESE (MN) *DIS		<0.02	<0.02	<0.02
MERCURY (HG) *DIS		<0.001	<0.001	<0.001
SELENIUM (SE) *DIS		<0.005	<0.005	<0.005
SILVER (AG) *DIS		<0.005	<0.005	<0.005
ZINC (ZN) *DIS	0.02			
-- VOLATILE ORGANICS --				
1,1,1,2-TETRACHLOROETHANE	<0.001			
1,1,1-TRICHLOROETHANE	<0.0005	<0.0005	<0.0005	<0.0005
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001	<0.001	<0.001
1,1-DICHLOROETHANE	0.0011	<0.001	<0.001	<0.001
1,1-DICHLOROETHENE	<0.0005	<0.0005	<0.0005	<0.0005
1,1-DICHLOROPROPENE	<0.001			
1,2-DIBROMOETHANE	<0.001			
1,2-DICHLOROETHANE	<0.0005	<0.0005	<0.0005	<0.0005
1,2-DICHLOROPROPANE	<0.001			
2,2-DICHLOROPROPANE	<0.001			
2-BUTANONE (METHYL-ETHYL-KETONE)		<0.01		
2-CHLOROETHYL VINYL ETHER		<0.01	<0.01	<0.01
2-CHLOROTOLUENE	<0.001			
2-HEXANONE		<0.01		
4-BROMOFLUOROBENZENE		<0.01	<0.01	<0.01
4-CHLOROTOLUENE	<0.001			
4-METHYL-2-PENTANONE		<0.01		
ACETONE		<0.01		
ACROLEIN		<0.01		
ACRYLONITRILE		<0.01		
BENZENE	<0.0005	<0.0005	<0.0005	<0.0005
BROMOBENZENE	<0.001			
BROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001	<0.001	<0.001
BROMOFORM	<0.001	<0.001	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001	<0.001	<0.001
CARBON DISULFIDE		<0.01		

* DIS - Dissolved
* TOT - Total

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Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	HL-90-3	HL-90-3	HL-90-3	HL-90-3
SAMPLE DATE	02/02/90	04/05/91	01/21/92	05/19/92
SAMPLE TIME	14:30	14:30	14:00	10:30
LAB	EL	EL	EL	EL
LAB NUMBER	90-2765	91-12770	92-4683	92-19269
SAMPLE NUMBER	HL-90-2-100	HL-9104-107	HL-9201-100	HL-9205-109
— VOLATILE ORGANICS —				
CARBON TETRACHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005
CHLOROBENZENE	<0.001	<0.001	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001	<0.001	<0.001
CHLOROFORM	0.0055	0.0058	0.0043	0.004
CHLOROMETHANE	<0.001	<0.001	<0.001	<0.001
CIS-1,2-DICHLOROETHENE	0.0018			
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001
DIBROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001	<0.001	<0.001
DICHLORODIFLUOROMETHANE	0.0013	<0.001	<0.001	<0.001
ETHANOL		<0.01		
ETHYL METHACRYLATE		<0.01	<0.01	<0.01
ETHYLBENZENE	<0.001	<0.001	<0.001	<0.001
IODOMETHANE		<0.01	<0.01	<0.01
XYLENE		<0.001	<0.001	<0.001
M-XYLENE	<0.001			
O-XYLENE	<0.001			
P-XYLENE	<0.001			
METHYLENE CHLORIDE	<0.001	<0.001	<0.001	<0.001
STYRENE	<0.001	<0.001	<0.001	<0.001
TETRACHLOROETHENE	0.0026	0.0019	0.0011	0.0017
TOLUENE	<0.001	<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001
TRICHLOROETHENE	0.0006	0.00065	<0.0005	<0.0005
TRICHLOROFLUOROMETHANE	<0.001	<0.001	<0.001	<0.001
VINYL ACETATE		<0.01	<0.01	<0.01
VINYL CHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005
-- SEMI-VOLATILE EXTRACTABLES —				
1,2,3-TRICHLOROBENZENE	<0.001			
1,2,3-TRICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001
1,2,4-TRICHLOROBENZENE	<0.001			
1,2,4-TRIMETHYLBENZENE	<0.001			
1,2-DIBROMO-3-CHLOROPROPANE	<0.001			

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* TOT - Total

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Blank line indicates parameter not tested.

Sample Type: Monitoring Wells

SITE CODE	HL-90-3	HL-90-3	HL-90-3	HL-90-3
SAMPLE DATE	02/02/90	04/05/91	01/21/92	05/19/92
SAMPLE TIME	14:30	14:30	14:00	10:30
LAB	EL	EL	EL	EL
LAB NUMBER	90-2765	91-12770	92-4683	92-19269
SAMPLE NUMBER	HL-90-2-100	HL-9104-107	HL-9201-100	HL-9205-109
-- SEMI-VOLATILE EXTRACTABLES --				
1,2-DICHLOROBENZENE	<0.001			
1,3,5-TRIMETHYLBENZENE	<0.001			
1,3-DICHLOROBENZENE	<0.001			
1,3-DICHLOROPROPANE	<0.001			
1,4-DICHLORO-2-BUTENE		<0.01		
1,4-DICHLOROBENZENE	<0.0005			
1,4-DIFLUOROBENZENE		<0.01	<0.01	<0.01
DICHLOROMONOFLUOROMETHANE	<0.001			
HEXACHLOROBUTADIENE	<0.001			
ISOPROPYLBENZENE	<0.001			
N-BUTYLBENZENE	<0.001			
N-PROPYLBENZENE	<0.001			
NAPHTHALENE	<0.001			
P-ISOPROPYLTOLUENE	<0.001			
SEC-BUTYLBENZENE	<0.001			
TERT-BUTYLBENZENE	<0.001			
-- HYDROCARBONS --				
ORGANIC CARBON		2.0		
-- OTHER PARAMETERS --				
CYANIDE (CN)				<0.005
CYANIDE (CN) *TOT		<0.005	<0.005	
CHEMICAL OXYGEN DEMAND		3.0	10.0	14.0

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	13	13	13	13	13	19	20	23
SAMPLE DATE	02/16/90	05/04/90	04/04/91	01/22/92	05/20/92	05/04/90	05/06/90	05/06/90
SAMPLE TIME	09:30	09:30	11:30	14:30	09:30	09:45	11:10	11:15
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-3298	90-10822	91-12763	92-4692	92-19276	90-10823	90-10825	90-10826
SAMPLE NUMBER	HL-90-10	HL-9005-105	HL-9104-100	HL-9201-109	HL-9205-105	HL-9005-106	HL-9005-108	HL-9005-109
-- VOLATILE ORGANICS --								
1,1,1,2-TETRACHLOROETHANE	<0.001	<0.001				<0.001	<0.001	<0.001
1,1,1-TRICHLOROETHANE	0.00078	0.00079	0.00088	0.001	0.0005	<0.0005	<0.0005	0.0019
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-DICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0011
1,1-DICHLOROETHENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,1-DICHLOROPROPENE	<0.001	<0.001				<0.001	<0.001	<0.001
1,2-DIBROMOETHANE	<0.001	<0.001				<0.001	<0.001	<0.001
1,2-DICHLOROETHANE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,2-DICHLOROPROPANE	<0.001	<0.001				<0.001	<0.001	<0.001
2,2-DICHLOROPROPANE	<0.001	<0.001				<0.001	<0.001	<0.001
2-BUTANONE (METHYL-ETHYL-KETONE)			<0.01					
2-CHLOROETHYL VINYL ETHER			<0.01	<0.01	<0.01			
2-CHLOROTOLUENE	<0.001	<0.001				<0.001	<0.001	<0.001
2-HEXANONE			<0.01					
4-BROMOFLUOROBENZENE			<0.01	<0.01	<0.01			
4-CHLOROTOLUENE	<0.001	<0.001				<0.001	<0.001	<0.001
4-METHYL-2-PENTANONE			<0.01					
ACETONE			<0.01					
ACROLEIN			<0.01					
ACRYLONITRILE			<0.01					
BENZENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BROMOBENZENE	<0.001	<0.001				<0.001	<0.001	<0.001
BROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOFORM	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CARBON DISULFIDE			<0.01					
CARBON TETRACHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
CHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROFORM	0.0029	0.0044	0.0036	0.0038	0.0024	<0.001	<0.001	0.007
CHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CIS-1,2-DICHLOROETHENE	<0.001	<0.001				<0.001	<0.001	<0.001
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	13	13	13	13	13	19	20	23
SAMPLE DATE	02/16/90	05/04/90	04/04/91	01/22/92	05/20/92	05/04/90	05/06/90	05/06/90
SAMPLE TIME	09:30	09:30	11:30	14:30	09:30	09:45	11:10	11:15
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-3298	90-10822	91-12763	92-4692	92-19276	90-10823	90-10825	90-10826
SAMPLE NUMBER	HL-90-10	HL-9005-105	HL-9104-100	HL-9201-109	HL-9205-105	HL-9005-106	HL-9005-108	HL-9005-109
-- VOLATILE ORGANICS --								
DIBROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DICHLORODIFLUOROMETHANE	0.0043	0.0023	0.0024	0.003	0.0021	<0.001	<0.001	0.0066
ETHANOL			<0.01					
ETHYL METHACRYLATE			<0.01	<0.01	<0.01			
ETHYLBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
IODOMETHANE			<0.01	<0.01	<0.01			
XYLENE			<0.001	<0.001	<0.001			
M-XYLENE	<0.001	<0.001				<0.001	<0.001	<0.001
O-XYLENE	<0.001	<0.001				<0.001	<0.001	<0.001
P-XYLENE	<0.001	<0.001				<0.001	<0.001	<0.001
METHYLENE CHLORIDE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0011
STYRENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TETRACHLOROETHENE	0.0027	0.0023	0.0034	0.0037	0.0022	<0.0005	<0.0005	0.0081
TOLUENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRICHLOROETHENE	<0.0005	0.00074	0.0005	0.00054	<0.0005	<0.0005	<0.0005	0.0018
TRICHLOROFLUOROMETHANE	<0.001	<0.001	<0.001	0.0012	<0.001	<0.001	<0.001	<0.001
VINYL ACETATE			<0.01	<0.01	<0.01			
VINYL CHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
-- SEMI-VOLATILE EXTRACTABLES --								
1,2,3-TRICHLOROBENZENE	<0.001	<0.001				<0.001	<0.001	<0.001
1,2,3-TRICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRICHLOROBENZENE	<0.001	<0.001				<0.001	<0.001	<0.001
1,2,4-TRIMETHYLBENZENE	<0.001	<0.001				<0.001	<0.001	<0.001
1,2-DIBROMO-3-CHLOROPROPANE	<0.001	<0.001				<0.001	<0.001	<0.001
1,2-DICHLOROBENZENE	<0.001	<0.001				<0.001	<0.001	<0.001
1,3,5-TRIMETHYLBENZENE	<0.001	<0.001				<0.001	<0.001	<0.001
1,3-DICHLOROBENZENE	<0.001	<0.001				<0.001	<0.001	<0.001
1,3-DICHLOROPROPANE	<0.001	<0.001				<0.001	<0.001	<0.001
1,4-DICHLORO-2-BUTENE			<0.01					
1,4-DICHLOROBENZENE	<0.0005	<0.0005				<0.0005	<0.0005	<0.0005
1,4-DIFLUOROBENZENE			<0.01	<0.01	<0.01			

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	13	13	13	13	13	19	20	23
SAMPLE DATE	02/16/90	05/04/90	04/04/91	01/22/92	05/20/92	05/04/90	05/06/90	05/06/90
SAMPLE TIME	09:30	09:30	11:30	14:30	09:30	09:45	11:10	11:15
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-3298	90-10822	91-12763	92-4692	92-19276	90-10823	90-10825	90-10826
SAMPLE NUMBER	HL-90-10	HL-9005-105	HL-9104-100	HL-9201-109	HL-9205-105	HL-9005-106	HL-9005-108	HL-9005-109
-- SEMI-VOLATILE EXTRACTABLES --								
DICHLOROMONOFLUOROMETHANE	0.001	<0.0019				<0.001	<0.001	0.0045
HEXACHLOROBUTADIENE	<0.001	<0.001				<0.001	<0.001	<0.001
ISOPROPYLBENZENE	<0.001	<0.001				<0.001	<0.001	<0.001
N-BUTYLBENZENE	<0.001	<0.001				<0.001	<0.001	<0.001
N-PROPYLBENZENE	<0.001	<0.001				<0.001	<0.001	<0.001
NAPHTHALENE	<0.001	<0.001				<0.001	<0.001	<0.001
P-ISOPROPYLTOLUENE	<0.001	<0.001				<0.001	<0.001	<0.001
SEC-BUTYLBENZENE	<0.001	<0.001				<0.001	<0.001	<0.001
TERT-BUTYLBENZENE	<0.001	<0.001				<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	26	28	31	31	31	31	32	34
SAMPLE DATE	05/03/90	06/05/90	05/03/90	04/13/91	01/29/92	05/28/92	05/03/90	05/06/90
SAMPLE TIME	11:00	10:30	12:50	13:20	17:20		11:40	11:00
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10817	90-15038	90-10820	91-13088	92-5002	92-19788	90-10818	90-10824
SAMPLE NUMBER	HL-9005-100	HL-9006-100	HL-9005-103	HL-9104-111	HL-9201-110	HL-9205-112	HL-9005-101	HL-9005-107
-- VOLATILE ORGANICS --								
1,1,1,2-TETRACHLOROETHANE	<0.001	<0.001	<0.001		*		<0.001	<0.001
1,1,1-TRICHLOROETHANE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-DICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-DICHLOROETHENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,1-DICHLOROPROPENE	<0.001	<0.001	<0.001				<0.001	<0.001
1,2-DIBROMOETHANE	<0.001	<0.001	<0.001				<0.001	<0.001
1,2-DICHLOROETHANE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,2-DICHLOROPROPANE	<0.001	<0.001	<0.001				<0.001	<0.001
2,2-DICHLOROPROPANE	<0.001	<0.001	<0.001				<0.001	<0.001
2-BUTANONE (METHYL-ETHYL-KETONE)				<0.01				
2-CHLOROETHYL VINYL ETHER				<0.01	<0.01	<0.01		
2-CHLOROTOLUENE	<0.001	<0.001	<0.001				<0.001	<0.001
2-HEXANONE				<0.01				
4-BROMOFLUOROBENZENE				<0.01	<0.01	<0.01		
4-CHLOROTOLUENE	<0.001	<0.001	<0.001				<0.001	<0.001
4-METHYL-2-PENTANONE				<0.01				
ACETONE				<0.01				
ACROLEIN				<0.01				
ACRYLONITRILE				<0.01				
BENZENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BROMOBENZENE	<0.001	<0.001	<0.001				<0.001	<0.001
BROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	0.0019	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOFORM	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CARBON DISULFIDE				<0.01				
CARBON TETRACHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
CHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROFORM	<0.001	0.014	0.01	0.0077	0.0088	0.009	<0.001	0.0056
CHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CIS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001				<0.001	<0.001
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	26	28	31	31	31	31	32	34
SAMPLE DATE	05/03/90	06/05/90	05/03/90	04/13/91	01/29/92	05/28/92	05/03/90	05/06/90
SAMPLE TIME	11:00	10:30	12:50	13:20	17:20		11:40	11:00
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10817	90-15038	90-10820	91-13088	92-5002	92-19788	90-10818	90-10824
SAMPLE NUMBER	HL-9005-100	HL-9006-100	HL-9005-103	HL-9104-111	HL-9201-110	HL-9205-112	HL-9005-101	HL-9005-107
-- VOLATILE ORGANICS --								
DIBROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DICHLORODIFLUOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
ETHANOL				<0.01				
ETHYL METHACRYLATE				<0.01	<0.01	<0.01		
ETHYLBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
IODOMETHANE				<0.01	<0.01	<0.01		
XYLENE				<0.001	<0.001	<0.001		
M-XYLENE	<0.001	<0.001	<0.001				<0.001	<0.001
O-XYLENE	<0.001	<0.001	<0.001				<0.001	<0.001
P-XYLENE	<0.001	<0.001	<0.001				<0.001	<0.001
METHYLENE CHLORIDE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
STYRENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TETRACHLOROETHENE	<0.0005	0.0074	0.0006	<0.0005	<0.0005	<0.0005	<0.0005	0.0022
TOLUENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRICHLOROETHENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
TRICHLOROFLUOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
VINYL ACETATE				<0.01	<0.01	<0.01		
VINYL CHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
-- SEMI-VOLATILE EXTRACTABLES --								
1,2,3-TRICHLOROBENZENE	<0.001	<0.001	<0.001				<0.001	<0.001
1,2,3-TRICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRICHLOROBENZENE	<0.001	<0.001	<0.001				<0.001	<0.001
1,2,4-TRIMETHYLBENZENE	<0.001	<0.001	<0.001				<0.001	<0.001
1,2-DIBROMO-3-CHLOROPROPANE	<0.001	<0.001	<0.001				<0.001	<0.001
1,2-DICHLOROBENZENE	<0.001	<0.001	<0.001				<0.001	<0.001
1,3,5-TRIMETHYLBENZENE	<0.001	<0.001	<0.001				<0.001	<0.001
1,3-DICHLOROBENZENE	<0.001	<0.001	<0.001				<0.001	<0.001
1,3-DICHLOROPROPANE	<0.001	<0.001	<0.001				<0.001	<0.001
1,4-DICHLORO-2-BUTENE				<0.01				
1,4-DICHLOROBENZENE	<0.0005	<0.0005	<0.0005				<0.0005	<0.0005
1,4-DIFLUOROBENZENE				<0.01	<0.01	<0.01		

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	26	28	31	31	31	31	32	34
SAMPLE DATE	05/03/90	06/05/90	05/03/90	04/13/91	01/29/92	05/28/92	05/03/90	05/06/90
SAMPLE TIME	11:00	10:30	12:50	13:20	17:20		11:40	11:00
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-10817	90-15038	90-10820	91-13088	92-5002	92-19788	90-10818	90-10824
SAMPLE NUMBER	HL-9005-100	HL-9006-100	HL-9005-103	HL-9104-111	HL-9201-110	HL-9205-112	HL-9005-101	HL-9005-107
-- SEMI-VOLATILE EXTRACTABLES --								
DICHLOROMONOFLUOROMETHANE	<0.001	<0.001	<0.001				<0.001	<0.001
HEXACHLOROBUTADIENE	<0.001	<0.001	<0.001				<0.001	<0.001
ISOPROPYLBENZENE	<0.001	<0.001	<0.001				<0.001	<0.001
N-BUTYLBENZENE	<0.001	<0.001	<0.001				<0.001	<0.001
N-PROPYLBENZENE	<0.001	<0.001	<0.001				<0.001	<0.001
NAPHTHALENE	<0.001	<0.001	<0.001				<0.001	<0.001
P-ISOPROPYLTOLUENE	<0.001	<0.001	<0.001				<0.001	<0.001
SEC-BUTYLBENZENE	<0.001	<0.001	<0.001				<0.001	<0.001
TERT-BUTYLBENZENE	<0.001	<0.001	<0.001				<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	36	38	38	38	40	40	40	42
SAMPLE DATE	06/05/90	05/03/90	05/03/90	01/22/92	05/06/90	04/13/91	05/28/92	05/03/90
SAMPLE TIME	11:00	13:10	13:40	14:15	12:15	13:40		12:20
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-15040	90-10821	90-10833	92-4691	90-10831	91-13086	92-19787	90-10819
REMARKS			DUPLICATE					
SAMPLE NUMBER	HL-9006-102	HL-9005-104	HL-9005-204	HL-9201-108	HL-9005-114	HL-9104-109	HL-9205-118	HL-9005-102
-- VOLATILE ORGANICS --								
1,1,1,2-TETRACHLOROETHANE	<0.001	<0.001	<0.001		<0.001			<0.001
1,1,1-TRICHLOROETHANE	<0.0005	<0.0005	<0.0005	<0.0005	0.0013	0.001	0.001	0.00089
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-DICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	0.0015	0.0012	0.0013	<0.001
1,1-DICHLOROETHENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,1-DICHLOROPROPENE	<0.001	<0.001	<0.001		<0.001			<0.001
1,2-DIBROMOETHANE	<0.001	<0.001	<0.001		<0.001			<0.001
1,2-DICHLOROETHANE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,2-DICHLOROPROPANE	<0.001	<0.001	<0.001		<0.001			<0.001
2,2-DICHLOROPROPANE	<0.001	<0.001	<0.001		<0.001			<0.001
2-BUTANONE (METHYL-ETHYL-KETONE)						<0.01		
2-CHLOROETHYL VINYL ETHER				<0.01		<0.01	<0.01	
2-CHLOROTOLUENE	<0.001	<0.001	<0.001		<0.001			<0.001
2-HEXANONE						<0.01		
4-BROMOFLUOROBENZENE				<0.01		<0.01	<0.01	
4-CHLOROTOLUENE	<0.001	<0.001	<0.001		<0.001			<0.001
4-METHYL-2-PENTANONE						<0.01		
ACETONE						<0.01		
ACROLEIN						<0.01		
ACRYLONITRILE						<0.01		
BENZENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BROMOBENZENE	<0.001	<0.001	<0.001		<0.001			<0.001
BROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOFORM	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CARBON DISULFIDE						<0.01		
CARBON TETRACHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
CHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROFORM	<0.001	0.009	0.0079	0.0074	0.011	0.011	0.0091	0.0028
CHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CIS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001		0.002			<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	36	38	38	38	40	40	40	42
SAMPLE DATE	06/05/90	05/03/90	05/03/90	01/22/92	05/06/90	04/13/91	05/28/92	05/03/90
SAMPLE TIME	11:00	13:10	13:40	14:15	12:15	13:40		12:20
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-15040	90-10821	90-10833	92-4691	90-10831	91-13086	92-19787	90-10819
REMARKS			DUPLICATE					
SAMPLE NUMBER	HL-9006-102	HL-9005-104	HL-9005-204	HL-9201-108	HL-9005-114	HL-9104-109	HL-9205-118	HL-9005-102
-- VOLATILE ORGANICS --								
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DICHLORODIFLUOROMETHANE	<0.001	<0.001	0.001	<0.001	0.0045	0.0021	0.0014	0.0046
ETHANOL						<0.01		
ETHYL METHACRYLATE				<0.01		<0.01	<0.01	
ETHYLBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
IODOMETHANE				<0.01		<0.01	<0.01	
XYLENE				<0.001		<0.001	<0.001	
M-XYLENE	<0.001	<0.001	<0.001		<0.001			<0.001
O-XYLENE	<0.001	<0.001	<0.001		<0.001			<0.001
P-XYLENE	<0.001	<0.001	<0.001		<0.001			<0.001
METHYLENE CHLORIDE	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001
STYRENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TETRACHLOROETHENE	<0.0005	0.0011	0.00097	0.00074	0.008	0.0056	0.0046	0.005
TOLUENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRICHLOROETHENE	<0.0005	<0.0005	<0.0005	<0.0005	0.0013	0.00088	0.001	0.0005
TRICHLOROFLUOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0011	<0.001
VINYL ACETATE				<0.01		<0.01	<0.01	
VINYL CHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
-- SEMI-VOLATILE EXTRACTABLES --								
1,2,3-TRICHLOROBENZENE	<0.001	<0.001	<0.001		<0.001			<0.001
1,2,3-TRICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRICHLOROBENZENE	<0.001	<0.001	<0.001		<0.001			<0.001
1,2,4-TRIMETHYLBENZENE	<0.001	<0.001	<0.001		<0.001			<0.001
1,2-DIBROMO-3-CHLOROPROPANE	<0.001	<0.001	<0.001		<0.001			<0.001
1,2-DICHLOROBENZENE	<0.001	<0.001	<0.001		<0.001			<0.001
1,3,5-TRIMETHYLBENZENE	<0.001	<0.001	<0.001		<0.001			<0.001
1,3-DICHLOROBENZENE	<0.001	<0.001	<0.001		<0.001			<0.001
1,3-DICHLOROPROPANE	<0.001	<0.001	<0.001		<0.001			<0.001
1,4-DICHLORO-2-BUTENE						<0.01		

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	36	38	38	38	40	40	40	42
SAMPLE DATE	06/05/90	05/03/90	05/03/90	01/22/92	05/06/90	04/13/91	05/28/92	05/03/90
SAMPLE TIME	11:00	13:10	13:40	14:15	12:15	13:40		12:20
LAB	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-15040	90-10821	90-10833	92-4691	90-10831	91-13086	92-19787	90-10819
REMARKS			DUPLICATE					
SAMPLE NUMBER	HL-9006-102	HL-9005-104	HL-9005-204	HL-9201-108	HL-9005-114	HL-9104-109	HL-9205-118	HL-9005-102
-- SEMI-VOLATILE EXTRACTABLES --								
1,4-DICHLOROBENZENE	<0.0005	<0.0005	<0.0005		<0.0005			<0.0005
1,4-DIFLUOROBENZENE				<0.01		<0.01	<0.01	
DICHLOROMONOFLUOROMETHANE	<0.001	<0.001	<0.001		0.0041			0.0024
HEXACHLOROBUTADIENE	<0.001	<0.001	<0.001		<0.001			<0.001
ISOPROPYLBENZENE	<0.001	<0.001	<0.001		<0.001			<0.001
N-BUTYLBENZENE	<0.001	<0.001	<0.001		<0.001			<0.001
N-PROPYLBENZENE	<0.001	<0.001	<0.001		<0.001			<0.001
NAPHTHALENE	<0.001	<0.001	<0.001		<0.001			<0.001
P-ISOPROPYLTOLUENE	<0.001	<0.001	<0.001		<0.001			<0.001
SEC-BUTYLBENZENE	<0.001	<0.001	<0.001		<0.001			<0.001
TERT-BUTYLBENZENE	<0.001	<0.001	<0.001		<0.001			<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	47	48	48	5	51	52	52
SAMPLE DATE	01/22/92	06/01/90	05/20/92	04/13/91	06/01/90	04/04/91	05/28/92
SAMPLE TIME	13:05	13:30	11:30	13:00	13:50	13:30	
LAB	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	92-4689	90-14925	92-19279	91-13087	90-14926	91-12765	92-19789
SAMPLE NUMBER	HL-9201-106	HL-0690-200	HL-9205-110	HL-9104-110	HL-0690-201	HL-9104-102	HL-9205-114
— VOLATILE ORGANICS —							
1,1,1,2-TETRACHLOROETHANE		<0.001			<0.001		
1,1,1-TRICHLOROETHANE	0.00061	0.00067	0.00054	<0.0005	0.00054	0.0006	0.00096
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-DICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-DICHLOROETHENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,1-DICHLOROPROPENE		<0.001			<0.001		
1,2-DIBROMOETHANE		<0.001			<0.001		
1,2-DICHLOROETHANE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,2-DICHLOROPROPANE		<0.001			<0.001		
2,2-DICHLOROPROPANE		<0.001			<0.001		
2-BUTANONE (METHYL-ETHYL-KETONE)				<0.01		<0.01	
2-CHLOROETHYL VINYL ETHER	<0.01		<0.01	<0.01		<0.01	<0.01
2-CHLOROTOLUENE		<0.001			<0.001		
2-HEXANONE				<0.01		<0.01	
4-BROMOFLUOROBENZENE	<0.01		<0.01	<0.01		<0.01	<0.01
4-CHLOROTOLUENE		<0.001			<0.001		
4-METHYL-2-PENTANONE				<0.01		<0.01	
ACETONE				<0.01		<0.01	
ACROLEIN				<0.01		<0.01	
ACRYLONITRILE				<0.01		<0.01	
BENZENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BROMOBENZENE		<0.001			<0.001		
BROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOFORM	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CARBON DISULFIDE				<0.01		<0.01	
CARBON TETRACHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
CHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROFORM	0.0032	0.0016	0.0015	0.0023	0.0023	0.0043	0.007
CHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CIS-1,2-DICHLOROETHENE		<0.001			<0.001		
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	47	48	48	5	51	52	52
SAMPLE DATE	01/22/92	06/01/90	05/20/92	04/13/91	06/01/90	04/04/91	05/28/92
SAMPLE TIME	13:05	13:30	11:30	13:00	13:50	13:30	
LAB	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	92-4689	90-14925	92-19279	91-13087	90-14926	91-12765	92-19789
SAMPLE NUMBER	HL-9201-106	HL-0690-200	HL-9205-110	HL-9104-110	HL-0690-201	HL-9104-102	HL-9205-114
— VOLATILE ORGANICS —							
DIBROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DICHLORODIFLUOROMETHANE	0.001	0.001	0.0011	<0.001	0.0018	0.0032	0.0031
ETHANOL				<0.01		<0.01	
ETHYL METHACRYLATE	<0.01		<0.01	<0.01		<0.01	<0.01
ETHYLBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
IODOMETHANE	<0.01		<0.01	<0.01		<0.01	<0.01
XYLENE	<0.001		<0.001	<0.001		<0.001	<0.001
M-XYLENE		<0.001			<0.001		
O-XYLENE		<0.001			<0.001		
P-XYLENE		<0.001			<0.001		
METHYLENE CHLORIDE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
STYRENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TETRACHLOROETHENE	0.0013	0.0017	0.0013	0.0005	0.0017	0.0022	0.0025
TOLUENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRICHLOROETHENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
TRICHLOROFLUOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0018
VINYL ACETATE	<0.01		<0.01	<0.01		<0.01	<0.01
VINYL CHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
-- SEMI-VOLATILE EXTRACTABLES —							
1,2,3-TRICHLOROBENZENE		<0.001			<0.001		
1,2,3-TRICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRICHLOROBENZENE		<0.001			<0.001		
1,2,4-TRIMETHYLBENZENE		<0.001			<0.001		
1,2-DIBROMO-3-CHLOROPROPANE		<0.001			<0.001		
1,2-DICHLOROBENZENE		<0.001			<0.001		
1,3,5-TRIMETHYLBENZENE		<0.001			<0.001		
1,3-DICHLOROBENZENE		<0.001			<0.001		
1,3-DICHLOROPROPANE		<0.001*			<0.001		
1,4-DICHLORO-2-BUTENE				<0.01		<0.01	
1,4-DICHLOROBENZENE		<0.0005			<0.0005		
1,4-DIFLUOROBENZENE	<0.01		<0.01	<0.01		<0.01	<0.01

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	47	48	48	5	51	52	52
SAMPLE DATE	01/22/92	06/01/90	05/20/92	04/13/91	06/01/90	04/04/91	05/28/92
SAMPLE TIME	13:05	13:30	11:30	13:00	13:50	13:30	
LAB	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	92-4689	90-14925	92-19279	91-13087	90-14926	91-12765	92-19789
SAMPLE NUMBER	HL-9201-106	HL-0690-200	HL-9205-110	HL-9104-110	HL-0690-201	HL-9104-102	HL-9205-114
— SEMI-VOLATILE EXTRACTABLES —							
DICHLOROMONOFLUOROMETHANE		<0.001			<0.001		
HEXACHLOROBUTADIENE		<0.001			<0.001		
ISOPROPYLBENZENE		<0.001			<0.001		
N-BUTYLBENZENE		<0.001			<0.001		
N-PROPYLBENZENE		<0.001			<0.001		
NAPHTHALENE		<0.001			<0.001		
P-ISOPROPYLTOLUENE		<0.001			<0.001		
SEC-BUTYLBENZENE		<0.001			<0.001		
TERT-BUTYLBENZENE		<0.001			<0.001		

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	59	59	59	59	67	67	68	75	75
SAMPLE DATE	06/01/90	04/04/91	01/22/92	05/20/92	06/01/90	06/01/90	04/04/91	01/22/92	05/20/92
SAMPLE TIME	14:50	14:00	11:40	10:20	16:05	16:00	12:00	13:30	10:45
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-14927	91-12766	92-4688	92-19277	90-14928	90-14929	91-12764	92-4690	92-19278
REMARKS					DEEP	SHALLOW			
SAMPLE NUMBER	HL-0690-202	HL-9104-103	HL-9201-105	HL-9205-102	HL-0690-203	HL-0690-204	HL-9104-101	HL-9201-107	HL-9205-100
-- VOLATILE ORGANICS --									
1,1,1,2-TETRACHLOROETHANE	<0.001				<0.001	<0.001			
1,1,1-TRICHLOROETHANE	<0.0005	<0.0005	0.00051	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-DICHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-DICHLOROETHENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,1-DICHLOROPROPENE	<0.001				<0.001	<0.001			
1,2-DIBROMOETHANE	<0.001				<0.001	<0.001			
1,2-DICHLOROETHANE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
1,2-DICHLOROPROPANE	<0.001				<0.001	<0.001			
2,2-DICHLOROPROPANE	<0.001				<0.001	<0.001			
2-BUTANONE (METHYL-ETHYL-KETONE)		<0.01					<0.01		
2-CHLOROETHYL VINYL ETHER		<0.01	<0.01	<0.01			<0.01	<0.01	<0.01
2-CHLOROTOLUENE	<0.001				<0.001	<0.001			
2-HEXANONE		<0.01					<0.01		
4-BROMOFLUOROBENZENE		<0.01	<0.01	<0.01			<0.01	<0.01	<0.01
4-CHLOROTOLUENE	<0.001				<0.001	<0.001			
4-METHYL-2-PENTANONE		<0.01					<0.01		
ACETONE		<0.01					<0.01		
ACROLEIN		<0.01					<0.01		
ACRYLONITRILE		<0.01					<0.01		
BENZENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
BROMOBENZENE	<0.001				<0.001	<0.001			
BROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOFORM	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CARBON DISULFIDE		<0.01					<0.01		
CARBON TETRACHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
CHLOROBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CHLOROFORM	0.0016	0.0018	0.0013	0.0013	<0.001	0.0011	<0.001	<0.001	<0.001
CHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
CIS-1,2-DICHLOROETHENE	<0.001				<0.001	<0.001			

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	59	59	59	59	67	67	68	75	75
SAMPLE DATE	06/01/90	04/04/91	01/22/92	05/20/92	06/01/90	06/01/90	04/04/91	01/22/92	05/20/92
SAMPLE TIME	14:50	14:00	11:40	10:20	16:05	16:00	12:00	13:30	10:45
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-14927	91-12766	92-4688	92-19277	90-14928	90-14929	91-12764	92-4690	92-19278
REMARKS					DEEP	SHALLOW			
SAMPLE NUMBER	HL-0690-202	HL-9104-103	HL-9201-105	HL-9205-102	HL-0690-203	HL-0690-204	HL-9104-101	HL-9201-107	HL-9205-100
— VOLATILE ORGANICS —									
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOCHLOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DICHLORODIFLUOROMETHANE	0.0013	0.0024	0.0018	0.0026	<0.001	<0.001	<0.001	<0.001	<0.001
ETHANOL		<0.01					<0.01		
ETHYL METHACRYLATE		<0.01	<0.01	<0.01			<0.01	<0.01	<0.01
ETHYLBENZENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
IODOMETHANE		<0.01	<0.01	<0.01			<0.01	<0.01	<0.01
XYLENE		<0.001	<0.001	<0.001			<0.001	<0.001	<0.001
M-XYLENE	<0.001				<0.001	<0.001			
O-XYLENE	<0.001				<0.001	<0.001			
P-XYLENE	<0.001				<0.001	<0.001			
METHYLENE CHLORIDE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
STYRENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TETRACHLOROETHENE	0.0011	0.0013	0.0016	0.0015	<0.0005	0.00064	<0.0005	<0.0005	<0.0005
TOLUENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TRICHLOROETHENE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
TRICHLOROFLUOROMETHANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
VINYL ACETATE		<0.01	<0.01	<0.01			<0.01	<0.01	<0.01
VINYL CHLORIDE	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
— SEMI-VOLATILE EXTRACTABLES —									
1,2,3-TRICHLOROBENZENE	<0.001				<0.001	<0.001			
1,2,3-TRICHLOROPROPANE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-TRICHLOROBENZENE	<0.001				<0.001	<0.001			
1,2,4-TRIMETHYLBENZENE	<0.001				<0.001	<0.001			
1,2-DIBROMO-3-CHLOROPROPANE	<0.001				<0.001	<0.001			
1,2-DICHLOROBENZENE	<0.001				<0.001	<0.001			
1,3,5-TRIMETHYLBENZENE	<0.001				<0.001	<0.001			
1,3-DICHLOROBENZENE	<0.001				<0.001	<0.001			
1,3-DICHLOROPROPANE	<0.001				<0.001	<0.001			
1,4-DICHLORO-2-BUTENE		<0.01					<0.01		

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	59	59	59	59	67	67	68	75	75
SAMPLE DATE	06/01/90	04/04/91	01/22/92	05/20/92	06/01/90	06/01/90	04/04/91	01/22/92	05/20/92
SAMPLE TIME	14:50	14:00	11:40	10:20	16:05	16:00	12:00	13:30	10:45
LAB	EL	EL	EL	EL	EL	EL	EL	EL	EL
LAB NUMBER	90-14927	91-12766	92-4688	92-19277	90-14928	90-14929	91-12764	92-4690	92-19278
REMARKS					DEEP	SHALLOW			
SAMPLE NUMBER	HL-0690-202	HL-9104-103	HL-9201-105	HL-9205-102	HL-0690-203	HL-0690-204	HL-9104-101	HL-9201-107	HL-9205-100
-- SEMI-VOLATILE EXTRACTABLES --									
1,4-DICHLOROBENZENE	<0.0005				<0.0005	<0.0005			
1,4-DIFLUOROBENZENE		<0.01	<0.01	<0.01			<0.01	<0.01	<0.01
DICHLOROMONOFLUOROMETHANE	<0.001				<0.001	<0.001			
HEXACHLOROBUTADIENE	<0.001				<0.001	<0.001			
ISOPROPYLBENZENE	<0.001				<0.001	<0.001			
N-BUTYLBENZENE	<0.001				<0.001	<0.001			
N-PROPYLBENZENE	<0.001				<0.001	<0.001			
NAPHTHALENE	<0.001				<0.001	<0.001			
P-ISOPROPYLTOLUENE	<0.001				<0.001	<0.001			
SEC-BUTYLBENZENE	<0.001				<0.001	<0.001			
TERT-BUTYLBENZENE	<0.001				<0.001	<0.001			

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	84	9
SAMPLE DATE	06/06/90	06/06/90
SAMPLE TIME	12:45	12:10
LAB	EL	EL
LAB NUMBER	90-15044	90-15042
SAMPLE NUMBER	HL-9006-106	HL-9006-104
— VOLATILE ORGANICS —		
1,1,1,2-TETRACHLOROETHANE	<0.001	<0.001
1,1,1-TRICHLOROETHANE	<0.0005	<0.0005
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001
1,1-DICHLOROETHANE	<0.001	<0.001
1,1-DICHLOROETHENE	<0.0005	<0.0005
1,1-DICHLOROPROPENE	<0.001	<0.001
1,2-DIBROMOETHANE	<0.001	<0.001
1,2-DICHLOROETHANE	<0.0005	<0.0005
1,2-DICHLOROPROPANE	<0.001	<0.001
2,2-DICHLOROPROPANE	<0.001	<0.001
2-CHLOROTOLUENE	<0.001	<0.001
4-CHLOROTOLUENE	<0.001	<0.001
BENZENE	<0.0005	<0.0005
BROMOBENZENE	<0.001	<0.001
BROMOCHLOROMETHANE	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001
BROMOFORM	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001
CARBON TETRACHLORIDE	<0.0005	<0.0005
CHLOROBENZENE	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001
CHLOROFORM	<0.001	<0.001
CHLOROMETHANE	<0.001	<0.001
CIS-1,2-DICHLOROETHENE	<0.001	<0.001
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001
DIBROMOCHLOROMETHANE	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001
DICHLORODIFLUOROMETHANE	<0.001	<0.001
ETHYLBENZENE	<0.001	<0.001
M-XYLENE	<0.001	<0.001
O-XYLENE	<0.001	<0.001
P-XYLENE	<0.001	<0.001
METHYLENE CHLORIDE	<0.001	<0.001
STYRENE	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Private Well

SITE CODE	84	9
SAMPLE DATE	06/06/90	06/06/90
SAMPLE TIME	12:45	12:10
LAB	EL	EL
LAB NUMBER	90-15044	90-15042
SAMPLE NUMBER	HL-9006-106	HL-9006-104
-- VOLATILE ORGANICS --		
TETRACHLOROETHENE	<0.0005	<0.0005
TOLUENE	<0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001
TRICHLOROETHENE	<0.0005	<0.0005
TRICHLOROFLUOROMETHANE	<0.001	<0.001
VINYL CHLORIDE	<0.0005	<0.0005
-- SEMI-VOLATILE EXTRACTABLES --		
1,2,3-TRICHLOROBENZENE	<0.001	<0.001
1,2,3-TRICHLOROPROPANE	<0.001	<0.001
1,2,4-TRICHLOROBENZENE	<0.001	<0.001
1,2,4-TRIMETHYLBENZENE	<0.001	<0.001
1,2-DIBROMO-3-CHLOROPROPANE	<0.001	<0.001
1,2-DICHLOROBENZENE	<0.001	<0.001
1,3,5-TRIMETHYLBENZENE	<0.001	<0.001
1,3-DICHLOROBENZENE	<0.001	<0.001
1,3-DICHLOROPROPANE	<0.001	<0.001
1,4-DICHLOROBENZENE	<0.0005	<0.0005
DICHLOROMONOFLUOROMETHANE	<0.001	<0.001
HEXACHLOROBUTADIENE	<0.001	<0.001
ISOPROPYLBENZENE	<0.001	<0.001
N-BUTYLBENZENE	<0.001	<0.001
N-PROPYLBENZENE	<0.001	<0.001
NAPHTHALENE	<0.001	<0.001
P-ISOPROPYLTOLUENE	<0.001	<0.001
SEC-BUTYLBENZENE	<0.001	<0.001
TERT-BUTYLBENZENE	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Quality Control

SITE CODE	D.I. BLANK	RINSBLANK
SAMPLE DATE	01/22/92	05/19/92
SAMPLE TIME	08:30	14:00
LAB	EL	EL
LAB NUMBER	92-4685	92-19271
SAMPLE NUMBER	HL-9201-102	HL-9205-107
— PHYSICAL PARAMETERS —		
PH	5.4	6.5
SC (UMHOS/CM @25 C)	2.0	11.0
TDS (@ 180 C)	<1.0	<1.0
TOTAL SUSPENDED SOLIDS	<1.0	<1.0
-- COMMON IONS --		
CALCIUM (CA) (DIS)	<1.0	<1.0
MAGNESIUM (MG) (DIS)	<1.0	<1.0
SODIUM (NA) (DIS)	<1.0	<1.0
POTASSIUM (K) (DIS)	<1.0	<1.0
TOTAL ALKALINITY AS CACO3	2.0	5.0
BICARBONATE (HCO3)	2.0	6.0
CARBONATE AS CO3	0.0	0.0
SULFATE (SO4)	<1.0	<1.0
CHLORIDE (CL)	<1.0	<1.0
-- NUTRIENTS --		
AMMONIA (NH3 AS N)	<0.1	<0.1
NITRATE (NO3-N)		<0.05
NITRATE + NITRITE AS N	<0.05	
— TRACE ELEMENTS —		
ARSENIC (AS) *DIS	<0.005	<0.005
BARIUM (BA) *DIS	<0.1	<0.1
CADMIUM (CD) *DIS	<0.001	<0.001
CHROMIUM (CR) *DIS	<0.02	<0.01
IRON (FE) *DIS	<0.03	<0.03
LEAD (PB) *DIS	<0.01	<0.01
MANGANESE (MN) *DIS	<0.02	<0.02
MERCURY (HG) *DIS	<0.001	<0.001
SELENIUM (SE) *DIS	<0.005	<0.005
SILVER (AG) *DIS	<0.005	<0.005
-- VOLATILE ORGANICS --		
1,1,1-TRICHLOROETHANE	0.00057	0.00054

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Quality Control

SITE CODE	D.I. BLANK	RINSBLANK
SAMPLE DATE	01/22/92	05/19/92
SAMPLE TIME	08:30	14:00
LAB	EL	EL
LAB NUMBER	92-4685	92-19271
SAMPLE NUMBER	HL-9201-102	HL-9205-107
— VOLATILE ORGANICS —		
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001
1,1-DICHLOROETHANE	<0.001	<0.001
1,1-DICHLOROETHENE	<0.0005	<0.0005
1,2-DICHLOROETHANE	<0.0005	<0.0005
2-CHLOROETHYL VINYL ETHER	<0.01	<0.01
4-BROMOFLUOROBENZENE	<0.01	<0.01
BENZENE	<0.0005	0.00058
BROMOCHLOROMETHANE	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001
BROMOFORM	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001
CARBON TETRACHLORIDE	<0.0005	<0.0005
CHLOROBENZENE	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001
CHLOROFORM	<0.001	<0.001
CHLOROMETHANE	<0.001	<0.001
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001
DIBROMOCHLOROMETHANE	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001
DICHLORODIFLUOROMETHANE	<0.001	<0.001
ETHYL METHACRYLATE	<0.01	<0.01
ETHYLBENZENE	<0.001	<0.001
IODOMETHANE	<0.01	<0.01
XYLENE	<0.001	<0.001
METHYLENE CHLORIDE	<0.001	<0.001
STYRENE	<0.001	<0.001
TETRACHLOROETHENE	<0.0005	0.001
TOLUENE	0.001	0.0023
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001
TRICHLOROETHENE	<0.0005	<0.0005 *
TRICHLOROFLUOROMETHANE	<0.001	<0.001
VINYL ACETATE	<0.01	<0.01
VINYL CHLORIDE	<0.0005	<0.0005

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Quality Control

SITE CODE	D.I. BLANK	RINSBLANK
SAMPLE DATE	01/22/92	05/19/92
SAMPLE TIME	08:30	14:00
LAB	EL	EL
LAB NUMBER	92-4685	92-19271
SAMPLE NUMBER	HL-9201-102	HL-9205-107
-- SEMI-VOLATILE EXTRACTABLES --		
1,2,3-TRICHLOROPROPANE	<0.001	<0.001
1,4-DIFLUOROBENZENE	<0.01	<0.01
-- OTHER PARAMETERS --		
CYANIDE (CN) *TOT	<0.005	<0.005
CHEMICAL OXYGEN DEMAND	<1.0	10.0

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Surface Water

SITE CODE	POND
SAMPLE DATE	05/06/90
SAMPLE TIME	11:35
LAB	EL
LAB NUMBER	90-10828
REMARKS	Golf Course P
SAMPLE NUMBER	HL-9005-111
— VOLATILE ORGANICS —	
1,1,1,2-TETRACHLOROETHANE	<0.001
1,1,1-TRICHLOROETHANE	<0.0005
1,1,2,2-TETRACHLOROETHANE	<0.001
1,1,2-TRICHLOROETHANE	<0.001
1,1-DICHLOROETHANE	<0.001
1,1-DICHLOROETHENE	<0.0005
1,1-DICHLOROPROPENE	<0.001
1,2-DIBROMOETHANE	<0.001
1,2-DICHLOROETHANE	<0.0005
1,2-DICHLOROPROPANE	<0.001
2,2-DICHLOROPROPANE	<0.001
2-CHLOROTOLUENE	<0.001
4-CHLOROTOLUENE	<0.001
BENZENE	<0.0005
BROMOBENZENE	<0.001
BROMOCHLOROMETHANE	<0.001
BROMODICHLOROMETHANE	<0.001
BROMOFORM	<0.001
BROMOMETHANE	<0.001
CARBON TETRACHLORIDE	<0.0005
CHLOROBENZENE	<0.001
CHLOROETHANE	<0.001
CHLOROFORM	<0.001
CHLOROMETHANE	<0.001
CIS-1,2-DICHLOROETHENE	<0.001
CIS-1,3-DICHLOROPROPENE	<0.001
DIBROMOCHLOROMETHANE	<0.001
DIBROMOMETHANE	<0.001
DICHLORODIFLUOROMETHANE	<0.001
ETHYLBENZENE	<0.001
M-XYLENE	<0.001
O-XYLENE	<0.001
P-XYLENE	<0.001
METHYLENE CHLORIDE	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Surface Water

SITE CODE	POND
SAMPLE DATE	05/06/90
SAMPLE TIME	11:35
LAB	EL
LAB NUMBER	90-10828
REMARKS	Golf Course P
SAMPLE NUMBER	HL-9005-111
— VOLATILE ORGANICS —	
STYRENE	<0.001
TETRACHLOROETHENE	<0.0005
TOLUENE	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001
TRICHLOROETHENE	<0.0005
TRICHLOROFLUOROMETHANE	<0.001
VINYL CHLORIDE	<0.0005
-- SEMI-VOLATILE EXTRACTABLES —	
1,2,3-TRICHLOROBENZENE	<0.001
1,2,3-TRICHLOROPROPANE	<0.001
1,2,4-TRICHLOROBENZENE	<0.001
1,2,4-TRIMETHYLBENZENE	<0.001
1,2-DIBROMO-3-CHLOROPROPANE	<0.001
1,2-DICHLOROBENZENE	<0.001
1,3,5-TRIMETHYLBENZENE	<0.001
1,3-DICHLOROBENZENE	<0.001
1,3-DICHLOROPROPANE	<0.001
1,4-DICHLOROBENZENE	<0.0005
DICHLOROMONOFLUOROMETHANE	<0.001
HEXACHLOROBUTADIENE	<0.001
ISOPROPYLBENZENE	<0.001
N-BUTYLBENZENE	<0.001
N-PROPYLBENZENE	<0.001
NAPHTHALENE	<0.001
P-ISOPROPYLTOLUENE	<0.001
SEC-BUTYLBENZENE	<0.001
TERT-BUTYLBENZENE	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Other Sites

SITE CODE	BLANK	BLANK
SAMPLE DATE	11/11/89	05/07/90
SAMPLE TIME	19:00	09:15
LAB	EL	EL
LAB NUMBER	89-20184	90-10832
SAMPLE NUMBER	HL-8911-005	HL-9005-115
-- VOLATILE ORGANICS --		
1,1,1,2-TETRACHLOROETHANE	<0.001	<0.001
1,1,1-TRICHLOROETHANE	<0.0005	<0.0005
1,1,2,2-TETRACHLOROETHANE	<0.001	<0.001
1,1,2-TRICHLOROETHANE	<0.001	<0.001
1,1-DICHLOROETHANE	<0.001	<0.001
1,1-DICHLOROETHENE	<0.0005	<0.0005
1,1-DICHLOROPROPENE	<0.001	<0.001
1,2-DIBROMOETHANE	<0.001	<0.001
1,2-DICHLOROETHANE	<0.0005	<0.0005
1,2-DICHLOROPROPANE	<0.001	<0.001
2,2-DICHLOROPROPANE	<0.001	<0.001
2-CHLOROTOLUENE	<0.001	<0.001
4-CHLOROTOLUENE	<0.001	<0.001
BENZENE	0.00073	<0.0005
BROMOBENZENE	<0.001	<0.001
BROMOCHLOROMETHANE	<0.001	<0.001
BROMODICHLOROMETHANE	<0.001	<0.001
BROMOFORM	<0.001	<0.001
BROMOMETHANE	<0.001	<0.001
CARBON TETRACHLORIDE	<0.0005	<0.0005
CHLOROBENZENE	<0.001	<0.001
CHLOROETHANE	<0.001	<0.001
CHLOROFORM	<0.001	<0.001
CHLOROMETHANE	<0.001	<0.001
CIS-1,2-DICHLOROETHENE	<0.001	<0.001
CIS-1,3-DICHLOROPROPENE	<0.001	<0.001
DIBROMOCHLOROMETHANE	<0.001	<0.001
DIBROMOMETHANE	<0.001	<0.001
DICHLORODIFLUOROMETHANE	<0.001	<0.001
ETHYLBENZENE	<0.001	<0.001
M-XYLENE	<0.001	<0.001
O-XYLENE	<0.001	<0.001
P-XYLENE	<0.001	<0.001
METHYLENE CHLORIDE	<0.001	<0.001
STYRENE	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

Sample Type: Other Sites

SITE CODE	BLANK	BLANK
SAMPLE DATE	11/11/89	05/07/90
SAMPLE TIME	19:00	09:15
LAB	EL	EL
LAB NUMBER	89-20184	90-10832
SAMPLE NUMBER	HL-8911-005	HL-9005-115
-- VOLATILE ORGANICS --		
TETRACHLOROETHENE	<0.0005	<0.0005
TOLUENE	0.001	<0.001
TRANS-1,2-DICHLOROETHENE	<0.001	<0.001
TRANS-1,3-DICHLOROPROPENE	<0.001	<0.001
TRICHLOROETHENE	<0.0005	<0.0005
TRICHLOROFLUOROMETHANE	<0.001	<0.001
VINYL CHLORIDE	<0.0005	<0.0005
-- SEMI-VOLATILE EXTRACTABLES --		
1,2,3-TRICHLOROBENZENE	<0.001	<0.001
1,2,3-TRICHLOROPROPANE	<0.001	<0.001
1,2,4-TRICHLOROBENZENE	<0.001	<0.001
1,2,4-TRIMETHYLBENZENE	<0.001	<0.001
1,2-DIBROMO-3-CHLOROPROPANE	<0.001	<0.001
1,2-DICHLOROBENZENE	<0.001	<0.001
1,3,5-TRIMETHYLBENZENE	<0.001	<0.001
1,3-DICHLOROBENZENE	<0.001	<0.001
1,3-DICHLOROPROPANE	<0.001	<0.001
1,4-DICHLOROBENZENE	<0.0005	<0.0005
DICHLOROMONOFLUOROMETHANE		<0.001
HEXACHLOROBUTADIENE	<0.001	<0.001
ISOPROPYLBENZENE	<0.001	<0.001
N-BUTYLBENZENE	<0.001	<0.001
N-PROPYLBENZENE	<0.001	<0.001
NAPHTHALENE	<0.001	<0.001
P-ISOPROPYLTOLUENE	<0.001	<0.001
SEC-BUTYLBENZENE	<0.001	<0.001
TERT-BUTYLBENZENE	<0.001	<0.001

* DIS - Dissolved
* TOT - Total

All quantities in mg/L (Water) or mg/kg (Soil) unless otherwise noted. All results are LABORATORY unless otherwise specified as field (FLD).
Blank line indicates parameter not tested.

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Page	Site Code	Site Name	Site Type	Elevation MP	Well Depth
25	13	13	Private Well		
25	19	19	Private Well		
25	20	20	Private Well		
25	23	23	Private Well		
28	26	26	Private Well		
28	28	28	Private Well		
28	31	31	Private Well		
28	32	32	Private Well		
28	34	34	Private Well		
31	36	36	Private Well		
31	38	38	Private Well		
31	40	40	Private Well		
31	42	42	Private Well		
34	47	47	Private Well		
34	48	48	Private Well		
34	5	5	Private Well		
34	51	51	Private Well		
34	52	52	Private Well		
37	59	59	Private Well		
37	67	67	Private Well		
37	68	68	Private Well		
37	75	75	Private Well		
3	82-2	82-2	Monitoring Wells		
3	82-3	82-3	Monitoring Wells		
3	82-4	82-4	Monitoring Wells		
3	83-5	83-5	Monitoring Wells		
3	83-6	83-6	Monitoring Wells	3990.86	
8	83-7	83-7	Monitoring Wells		
40	84	84	Private Well		
40	9	9	Private Well		
47	BLANK	BLANK	Other Sites		
42	D.I. BLANK	D.I. BLANK	Quality Control		
8	EPA-1	EPA-1	Monitoring Wells	3986.00	
8	FAIR GRND	FAIRGROUND-CITY WATER	Monitoring Wells		
8	HL-1	HL-1	Monitoring Wells		
12	HL-2	HL-2	Monitoring Wells		
12	HL-3	HL-3	Monitoring Wells		
12	HL-5	HL-5	Monitoring Wells		
12	HL-6	HL-6	Monitoring Wells		
12	HL-7	HL-7	Monitoring Wells		
12	HL-90-1	HL-90-1	Monitoring Wells	3942.48	

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Page	Site Code	Site Name	Site Type	Elevation MP	Well Depth
15	HL-90-2	HL-90-2	Monitoring Wells	3950.96	
21	HL-90-3	HL-90-3	Monitoring Wells	3958.29	
1	I-3	I-3 GOLF COURSE	Irrigation Well		
45	POND	GOLF COURSE POND	Surface Water		
42	RINSBLANK	RINSATE BLANK	Quality Control		

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34	HL-0690-200	90-14925	06/01/90	48
34	HL-0690-201	90-14926	06/01/90	51
37	HL-0690-202	90-14927	06/01/90	59
37	HL-0690-203	90-14928	06/01/90	67
37	HL-0690-204	90-14929	06/01/90	67
3	HL-8911-001	89-20180	11/11/89	82-4
3	HL-8911-002	89-20181	11/11/89	82-2
12	HL-8911-003	89-20182	11/11/89	HL-7
8	HL-8911-004	89-20183	11/11/89	83-7
47	HL-8911-005	89-20184	11/11/89	BLANK
8	HL-8911-006	89-20185	11/13/89	HL-1
3	HL-8911-900		11/13/89	83-6
3	HL-8911-901		11/13/89	83-5
12	HL-8911-902		11/13/89	HL-2
12	HL-8911-903		11/13/89	HL-3
3	HL-8911-904		11/13/89	82-3
12	HL-8911-905		11/13/89	HL-5
25	HL-90-10	90-3298	02/16/90	13
21	HL-90-2-100	90-2765	02/02/90	HL-90-3
28	HL-9005-100	90-10817	05/03/90	26
28	HL-9005-101	90-10818	05/03/90	32
31	HL-9005-102	90-10819	05/03/90	42
28	HL-9005-103	90-10820	05/03/90	31
31	HL-9005-104	90-10821	05/03/90	38
25	HL-9005-105	90-10822	05/04/90	13
25	HL-9005-106	90-10823	05/04/90	19
28	HL-9005-107	90-10824	05/06/90	34
25	HL-9005-108	90-10825	05/06/90	20
25	HL-9005-109	90-10826	05/06/90	23
8	HL-9005-110	90-10827	05/06/90	HL-1
45	HL-9005-111	90-10828	05/06/90	POND
12	HL-9005-112	90-10829	05/06/90	HL-5
12	HL-9005-113	90-10830	05/06/90	HL-6
31	HL-9005-114	90-10831	05/06/90	40
47	HL-9005-115	90-10832	05/07/90	BLANK
1	HL-9005-116	90-12196	05/08/90	I-3
15	HL-9005-120	90-12197	05/10/90	HL-90-2
15	HL-9005-121	90-12198	05/11/90	HL-90-1
3	HL-9005-122	90-12199	05/11/90	82-4
31	HL-9005-204	90-10833	05/03/90	38

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3		HL-8911-901	11/13/89	83-5
3		HL-8911-900	11/13/89	83-6
12		HL-8911-902	11/13/89	HL-2
12		HL-8911-903	11/13/89	HL-3
12		HL-8911-905	11/13/89	HL-5
3	89-20180	HL-8911-001	11/11/89	82-4
3	89-20181	HL-8911-002	11/11/89	82-2
12	89-20182	HL-8911-003	11/11/89	HL-7
8	89-20183	HL-8911-004	11/11/89	83-7
47	89-20184	HL-8911-005	11/11/89	BLANK
8	89-20185	HL-8911-006	11/13/89	HL-1
28	90-10817	HL-9005-100	05/03/90	26
28	90-10818	HL-9005-101	05/03/90	32
31	90-10819	HL-9005-102	05/03/90	42
28	90-10820	HL-9005-103	05/03/90	31
31	90-10821	HL-9005-104	05/03/90	38
25	90-10822	HL-9005-105	05/04/90	13
25	90-10823	HL-9005-106	05/04/90	19
28	90-10824	HL-9005-107	05/06/90	34
25	90-10825	HL-9005-108	05/06/90	20
25	90-10826	HL-9005-109	05/06/90	23
8	90-10827	HL-9005-110	05/06/90	HL-1
45	90-10828	HL-9005-111	05/06/90	POND
12	90-10829	HL-9005-112	05/06/90	HL-5
12	90-10830	HL-9005-113	05/06/90	HL-6
31	90-10831	HL-9005-114	05/06/90	40
47	90-10832	HL-9005-115	05/07/90	BLANK
31	90-10833	HL-9005-204	05/03/90	38
1	90-12196	HL-9005-116	05/08/90	I-3
15	90-12197	HL-9005-120	05/10/90	HL-90-2
15	90-12198	HL-9005-121	05/11/90	HL-90-1
3	90-12199	HL-9005-122	05/11/90	82-4
34	90-14925	HL-0690-200	06/01/90	48
34	90-14926	HL-0690-201	06/01/90	51
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37	90-14928	HL-0690-203	06/01/90	67
37	90-14929	HL-0690-204	06/01/90	67
28	90-15038	HL-9006-100	06/05/90	28
8	90-15039	HL-9006-101	06/05/90	FAIR GRND

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8	HL-9006-101	90-15039	06/05/90	FAIR GRND
31	HL-9006-102	90-15040	06/05/90	36
40	HL-9006-104	90-15042	06/06/90	9
40	HL-9006-106	90-15044	06/06/90	84
25	HL-9104-100	91-12763	04/04/91	13
37	HL-9104-101	91-12764	04/04/91	68
34	HL-9104-102	91-12765	04/04/91	52
37	HL-9104-103	91-12766	04/04/91	59
15	HL-9104-104	91-12767	04/04/91	HL-90-2
8	HL-9104-105	91-12768	04/05/91	EPA-1
3	HL-9104-106	91-12769	04/05/91	83-6
21	HL-9104-107	91-12770	04/05/91	HL-90-3
15	HL-9104-108	91-12771	04/05/91	HL-90-1
31	HL-9104-109	91-13086	04/13/91	40
34	HL-9104-110	91-13087	04/13/91	5
28	HL-9104-111	91-13088	04/13/91	31
15	HL-9104-118	91-12772	04/05/91	HL-90-1
21	HL-9201-100	92-4683	01/21/92	HL-90-3
15	HL-9201-101	92-4684	01/21/92	HL-90-1
42	HL-9201-102	92-4685	01/22/92	D.I. BLANK
8	HL-9201-103	92-4687	01/22/92	EPA-1
15	HL-9201-104	92-4686	01/22/92	HL-90-2
37	HL-9201-105	92-4688	01/22/92	59
34	HL-9201-106	92-4689	01/22/92	47
37	HL-9201-107	92-4690	01/22/92	75
31	HL-9201-108	92-4691	01/22/92	38
25	HL-9201-109	92-4692	01/22/92	13
28	HL-9201-110	92-5002	01/29/92	31
3	HL-9201-111	92-5001	01/31/92	83-6
37	HL-9205-100	92-19278	05/20/92	75
15	HL-9205-101	92-19272	05/19/92	HL-90-2
37	HL-9205-102	92-19277	05/20/92	59
8	HL-9205-103	92-19274	05/19/92	83-6
25	HL-9205-105	92-19276	05/20/92	13
42	HL-9205-107	92-19271	05/19/92	RINSBLANK
21	HL-9205-109	92-19269	05/19/92	HL-90-3
34	HL-9205-110	92-19279	05/20/92	48
28	HL-9205-112	92-19788	05/28/92	31
34	HL-9205-114	92-19789	05/28/92	52

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40	90-15042	HL-9006-104	06/06/90	9
40	90-15044	HL-9006-106	06/06/90	84
21	90-2765	HL-90-2-100	02/02/90	HL-90-3
12	90-2766	HL90-2-101	02/02/90	HL-90-1
15	90-2767	HL90-2-102	02/03/90	HL-90-2
25	90-3298	HL-90-10	02/16/90	13
25	91-12763	HL-9104-100	04/04/91	13
37	91-12764	HL-9104-101	04/04/91	68
34	91-12765	HL-9104-102	04/04/91	52
37	91-12766	HL-9104-103	04/04/91	59
15	91-12767	HL-9104-104	04/04/91	HL-90-2
8	91-12768	HL-9104-105	04/05/91	EPA-1
3	91-12769	HL-9104-106	04/05/91	83-6
21	91-12770	HL-9104-107	04/05/91	HL-90-3
15	91-12771	HL-9104-108	04/05/91	HL-90-1
15	91-12772	HL-9104-118	04/05/91	HL-90-1
31	91-13086	HL-9104-109	04/13/91	40
34	91-13087	HL-9104-110	04/13/91	5
28	91-13088	HL-9104-111	04/13/91	31
21	92-19269	HL-9205-109	05/19/92	HL-90-3
15	92-19270	HL-9205-122	05/19/92	HL-90-1
42	92-19271	HL-9205-107	05/19/92	RINSBLANK
15	92-19272	HL-9205-101	05/19/92	HL-90-2
15	92-19273	HL-9205-119	05/19/92	HL-90-2
8	92-19274	HL-9205-103	05/19/92	83-6
8	92-19275	HL-9205-123	05/20/92	EPA-1
25	92-19276	HL-9205-105	05/20/92	13
37	92-19277	HL-9205-102	05/20/92	59
37	92-19278	HL-9205-100	05/20/92	75
34	92-19279	HL-9205-110	05/20/92	48
31	92-19787	HL-9205-118	05/28/92	40
28	92-19788	HL-9205-112	05/28/92	31
34	92-19789	HL-9205-114	05/28/92	52
21	92-4683	HL-9201-100	01/21/92	HL-90-3
15	92-4684	HL-9201-101	01/21/92	HL-90-1
42	92-4685	HL-9201-102	01/22/92	D.I. BLANK
15	92-4686	HL-9201-104	01/22/92	HL-90-2
8	92-4687	HL-9201-103	01/22/92	EPA-1
37	92-4688	HL-9201-105	01/22/92	59

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15	HL-9205-122	92-19270	05/19/92	HL-90-1
8	HL-9205-123	92-19275	05/20/92	EPA-1
12	HL90-2-101	90-2766	02/02/90	HL-90-1
15	HL90-2-102	90-2767	02/03/90	HL-90-2

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37	92-4690	HL-9201-107	01/22/92	75
31	92-4691	HL-9201-108	01/22/92	38
25	92-4692	HL-9201-109	01/22/92	13
3	92-5001	HL-9201-111	01/31/92	83-6
28	92-5002	HL-9201-110	01/29/92	31

APPENDIX B.

STORM DRAIN OUTFALL FLOW MEASUREMENTS

HYDROMETRICS HELENA, MT

FLOW DISCHARGE CALCULATION

Project: City of Helena Landfill
Station: hlsr-2
Date Measured: 05-16-91

STATION	DIST. (ft)	WIDTH (ft)	DEPTH (ft)	VEL. (ft/sec)	AREA (ft^2)	DISCHARGE (cfs)
						0
E.O.W.	0.30	0.15	0	0		
1	0.60	0.25	0.15	0.28	0.04	0.01
2	0.80	0.20	0.20	0.25	0.04	0.00
3	1.00	0.20	0.20	0.30	0.04	0.01
4	1.20	0.20	0.30	0.30	0.06	0.02
5	1.40	0.20	0.30	0.38	0.06	0.02
6	1.60	0.20	0.25	0.43	0.05	0.02
7	1.80	0.20	0.20	0.32	0.04	0.01
8	2.00	0.20	0.15	0.22	0.03	0.00
9	2.20	0.15	0.05	0.17	0.00	0.00
E.O.W.	2.30	0.05	0	0		0
					Flow =	0.12

Flow Method: Pygmy Current Meter
Calc. Method: Rectangular Area Method
Gage Height: ft. Water Temp. (C): Air Temp. (C):
Weather: Partly Cloudy Measured by: WGP
Measurement Conditions: FAIR (8 %)
Calculated Flow: 0.12 ± 0.00cfs
Process program and date: HCM-05 (05-17-1991)

25' downstream from tunnel

HYDROMETRICS HELENA, MT

FLOW DISCHARGE CALCULATION

Project: City of Helena Landfill
Station: Mstr-2
Date Measured: 05-15-91

STATION	DIST. (ft)	WIDTH (ft)	DEPTH (ft)	VEL. (ft/sec)	AREA (ft^2)	DISCHARGE (cfs)
E.O.W.	0.30	0.15	0	0		0
1	0.60	0.25	0.15	0.28	0.04	0.01
2	0.80	0.20	0.20	0.25	0.04	0.00
3	1.00	0.20	0.20	0.30	0.04	0.01
4	1.20	0.20	0.30	0.20	0.06	0.01
5	1.40	0.20	0.30	0.35	0.06	0.02
6	1.60	0.20	0.25	0.43	0.05	0.02
7	1.80	0.20	0.20	0.32	0.04	0.01
8	2.00	0.20	0.15	0.22	0.03	0.00
9	2.20	0.16	0.05	0.17	0.00	0.00
E.O.W.	2.30	0.05	0	0		0

Flow = 0.12

HYDROMETRICS HELENA, MT

FLOW DISCHARGE CALCULATION

Project: City of Helena Landfill
Station: GLSR-1
Date Measured: 05-14-91

STATION	DIST (ft)	WIDTH (ft)	DEPTH (ft)	VEL. (ft/sec)	AREA (ft^2)	DISCHARGE (cfs)
E.O.W.	2.00	0.15				0
1	3.10	0.30	0.13	0.00	0.04	0.00
2	3.60	0.30	0.30	0.30	0.09	0.03
3	3.80	0.30	0.40	0.78	0.12	0.09
4	3.30	0.30	0.55	0.72	0.15	0.11
5	3.30	0.30	0.60	0.88	0.18	0.16
6	3.80	0.30	0.40	0.71	0.12	0.09
7	4.10	0.30	0.40	0.60	0.12	0.07
8	4.40	0.30	0.33	0.00	0.10	0.00
9	4.70	0.30	0.41	0.00	0.13	0.00
10	5.00	0.30	0.30	0.00	0.09	0.00
E.O.W.	5.30	0.11	0	0		0

Flow = 0.38

Flow Method: Pygmy Current Meter
Calc. Method: Rectangular Area Method
Gage Height: ft. Water Temp. (C): Air Temp. (C):
Weather: Partly Cloudy Measured By: WSP
Measurement Conditions: Fair (8 K)
Calculated Flow: 0.38 +/- 0.0 cfs
Process program and data: GLSR-05 (05-17-1991)

65 Inside front cover

HYDROMETRICS HELENA, MT

FLOW DISCHARGE CALCULATION

Project: City of Helena Landfill
Station: HLSR-1
Date Measured: 05-16-91

STATION	DIST. (ft)	WIDTH (ft)	DEPTH (ft)	VEL. (ft/sec)	AREA (ft^2)	DISCHARGE (cfs)
						0
E.O.W.	2.00	0.15	0	0		
1	2.30	0.30	0.15	0.00	0.04	0.00
2	2.60	0.30	0.30	0.30	0.09	0.03
3	2.90	0.30	0.40	0.28	0.12	0.03
4	3.20	0.30	0.55	0.17	0.16	0.03
5	3.50	0.30	0.60	0.22	0.18	0.04
6	3.80	0.30	0.60	0.17	0.18	0.03
7	4.10	0.30	0.60	0.08	0.18	0.01
8	4.40	0.30	0.55	0.05	0.16	0.00
9	4.70	0.30	0.45	0.00	0.13	0.00
10	5.00	0.30	0.30	0.00	0.09	0.00
E.O.W.	5.30	0.15	0	0		0
					Flow =	0.18

Flow Method: Pygmy Current Meter
Calc. Method: Rectangular Area Method
Gage Height: ft. Water Temp. (C): Air Temp. (C):
Weather: Partly Cloudy Measured by: wgp
Measurement Conditions: FAIR (8 %)
Calculated Flow: 0.18 + 0.01cfs
Process program and date: HCM-05 (05-17-1991)

65' Inside tunnel

HYDROMETRICS HELENA, MT

FLOW DISCHARGE CALCULATION

Project: City of Helena Landfill
Station: HLS-1
Date Measured: 05-10-91

STATION	DIST. (ft)	WIDTH (ft)	DEPTH (ft)	VEL. (ft/sec)	AREA (ft^2)	DISCHARGE (cfs)
E.O.W.	0.00	0.15	0	0		0
1	2.20	0.30	0.15	0.00	0.04	0.00
2	2.60	0.30	0.30	0.30	0.09	0.03
3	2.90	0.30	0.40	0.26	0.12	0.03
4	3.20	0.30	0.55	0.17	0.16	0.03
5	3.32	0.30	0.60	0.22	0.18	0.04
6	3.80	0.30	0.60	0.17	0.18	0.03
7	4.10	0.30	0.60	0.06	0.18	0.01
8	4.40	0.30	0.55	0.05	0.16	0.00
9	4.70	0.30	0.45	0.00	0.13	0.00
10	5.00	0.30	0.30	0.00	0.09	0.00
E.O.W.	5.30	0.15	0	0		0

Flow = 0.16

Flow Method: Pygmy Current Meter
Calc. Method: Rectangular Area Method
Gage Height: ft. Water Temp. (C): Air Temp. (C):
Weather: Partly Cloudy Measured by: VGP
Measurement Conditions: FAIR (8 K)
Calculated Flow: 0.16 + 0.01cfs
Process Program and date: HCH-05 (05-17-1991)

CS Tunnel

HYDROMETRICS

STREAM GAGING - PIGMY METER (0.6 DEPTH)

PROJECT Coit-Landfill DATE 5

SITE HWY 3 FLOW

DIST. FROM INITIAL POINT	WIDTH	DEPTH	AREA	REVOLUTIONS	TIME IN SECONDS	POINT VELOCITY (FT/SEC)	DISCHARGE (CFS)
				1			
	0.33						
	1"		U-HOOK				
	6						
			"				
	.1564				CFS		

PARTY _____ COMP. BY _____ CKED. BY _____

WEATHER _____ AIR TEMP. _____ WATER TEMP. _____

STREAM & BOTTOM COND. _____

MEAS. COND. RATING GOOD (5%), FAIR (0%), POOR (12%), VERY POOR (20%).

OTHER (EXPLAIN) _____

GAGE HEIGHT _____ REMARKS _____

143' OUTSIDE TANKS

HYDROMETRICS

STREAM GAGING – PIGMY METER (0.6 DEPTH)

PROJECT COH – Cruff. II DATE 5-16-91

SITE #SK-4 FLOW

DIST. FROM INITIAL POINT	WIDTH	DEPTH	AREA	REVOLUTIONS	TIME IN SECONDS	POINT VELOCITY (FT/SEC)	DISCHARGE (CFS)
	0.17						
			V-NOTCH				
	=	.0298 CFS					
	WATER GONE						
					378		

PARTY _____ COMP. BY _____ CKED. BY _____

WEATHER _____ AIR TEMP. _____ WATER TEMP. _____

STREAM & BOTTOM COND. _____

MEAS. COND. & RATING GOOD (5%), FAIR (8%), POOR (12%), VERY POOR (20%).

OTHER (EXPLAIN) _____

GAGE HEIGHT _____ REMARKS _____

300' OUTSIDE TUNNEL

APPENDIX C.

COVER SOIL TESTING DATA

File - Helena Landf. II

Letter of Transmittal

BRAUN INTERTEC

Braun Intertec Corporation

To: Steve Downs
Hydrometrics, Inc.
2727 Airport Road
Helena, MT 59601

Date: 1/12/93
Job No: BHDX-92-212L

Re: Permeability Test & Proctor
P.O. # 5225

We are sending you the following items: ☒ attached ☐ under separate cover via

1 Permeability Test
1 Proctor

These are being sent: ☐ for approval ☐ for review and comment ☒ for your use ☒ as requested

Remarks:

RECEIVED
JAN 13 1993

Copy to:

Signed: Nathan P. Borchard
Title: Materials Engr.
Phone:

BRAUN
INTERTEC

Letter of Transmittal

PERMEABILITY TEST – ASTM D 5084

METHOD A – CONSTANT HEAD/METHOD C – FALLING HEAD – RISING TAILWATER

Project: BHDX–92–212L Date: 1/4/93

Boring: _____ Sample #: HLWS–100 (WAIMART SOILS) Depth: _____

Description: SANDY LEAN CLAY with GRAVEL, low plasticity, fine to coarse grained gravel, gray.
Sample was remolded to approximately 90% of standard proctor.

	Initial		Final
Wt Specimen + Tare Wet	143.56	Wt Specimen + Tare Wet	740.20
Wt Specimen + Tare Dry	128.65	Wt Specimen + Tare Dry	624.80
Wt Tare	34.95	Wt Tare	115.40
Moisture Content	15.9%	Moisture Content	22.7%

Diameter	2.87 in	A = (2.87=41.74 cm2) or (1.94 = 19.07 cm2)	41.74 cm2		
Height L=	7.5 cm	Wt of specimen (gms)	600.70	Dry Unit Wt. (pcf)	103.4
Sp. Gravity	2.650	Initial Saturation	70.3%	Final Saturation	100.1%

Burette Area a=1 cm2 or 0.713 cm2 0.7263 Differential pressure 1 psi = 70.3 cm

Confining Pressure (psi) 5.0 Overburden 720 psf

	Time (t) sec	H1 cm	H2 cm	hi cm	hf cm	havg cm	Q cc	Method A K cm/sec	Method C K cm/sec
Initial	0	23.2	32.6	60.9					
Final	39660	16.5	39.3		47.5	54.2	4.8662		
Result								4.1E–07	4.1E–07
Initial	0	49.6	6.1	113.8					
Final	49200	34	21.7		82.6	98.2	11.3303		
Result								4.2E–07	4.2E–07
Initial	0	25.6	30.1	65.8					
Final	109260	9.2	46.5		33.0	49.4	11.9113		
Result								4.0E–07	4.1E–07
Initial	0	22.6	33.3	59.6					
Final	67920	12	43.8		38.5	49.1	7.6625		
Result								4.1E–07	4.2E–07
Average Permeability								4.1E–07	4.2E–07
Assigned Permeability									

Remarks: B coeficient = 98%
A specific gravity of 2.65 was assumed for the purpose of saturation calculations.

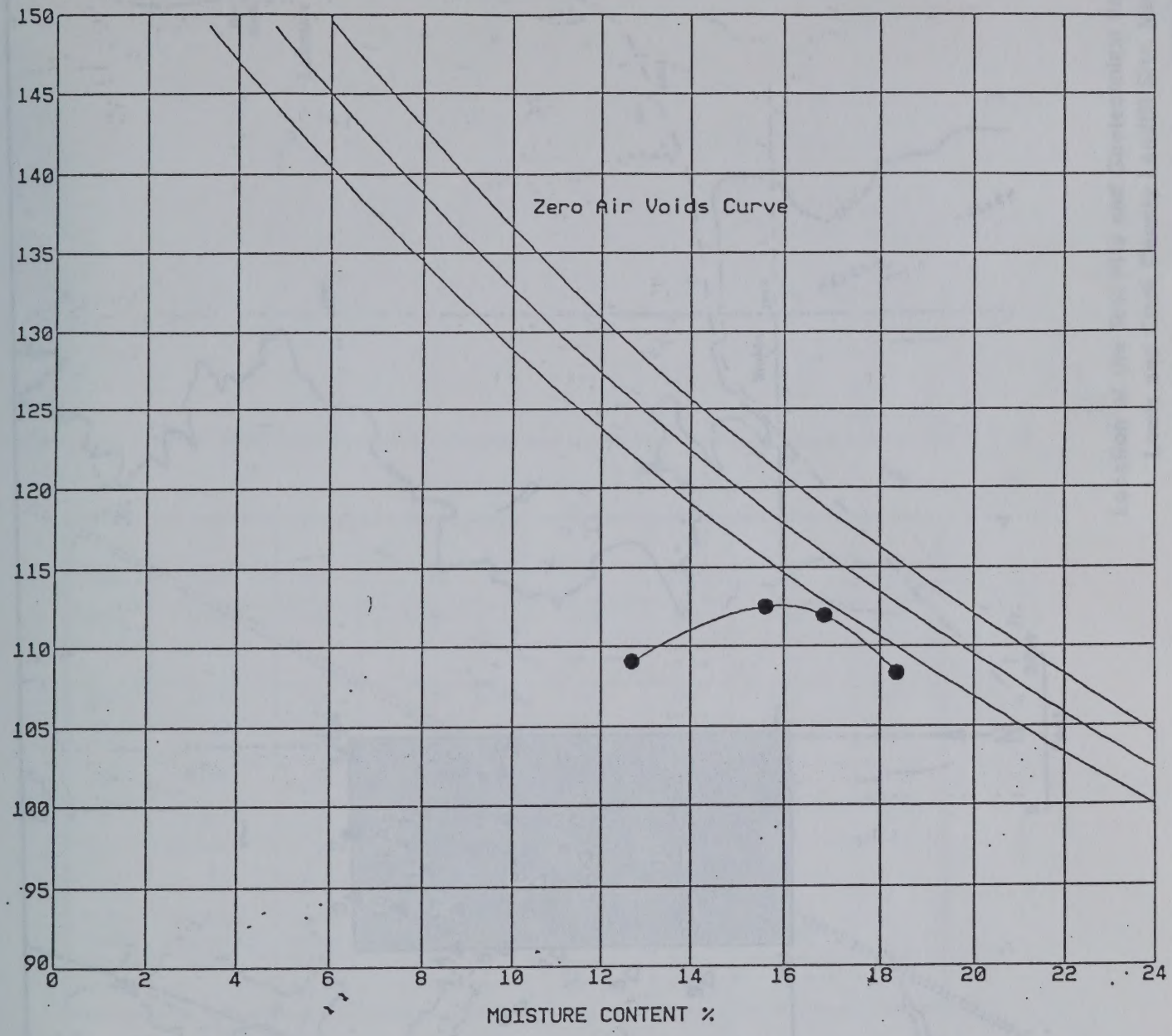
BRAUN INTERTEC

Braun Intertec Engineering, Inc.

Nathan P. Borsland

Materials Engineer

Walmart Borrow Area



	MAXIMUM DRY DENSITY, pcf	OPTIMIUM MOISTURE CONTENT %
SAMPLE NO: HLWS-100 DEPTH: ---	112.5	15.5

Soil Description: GRAVELLY CLAY, medium plasticity, fine to coarse grained gravel brown.

ASTM D 698
METHOD: C

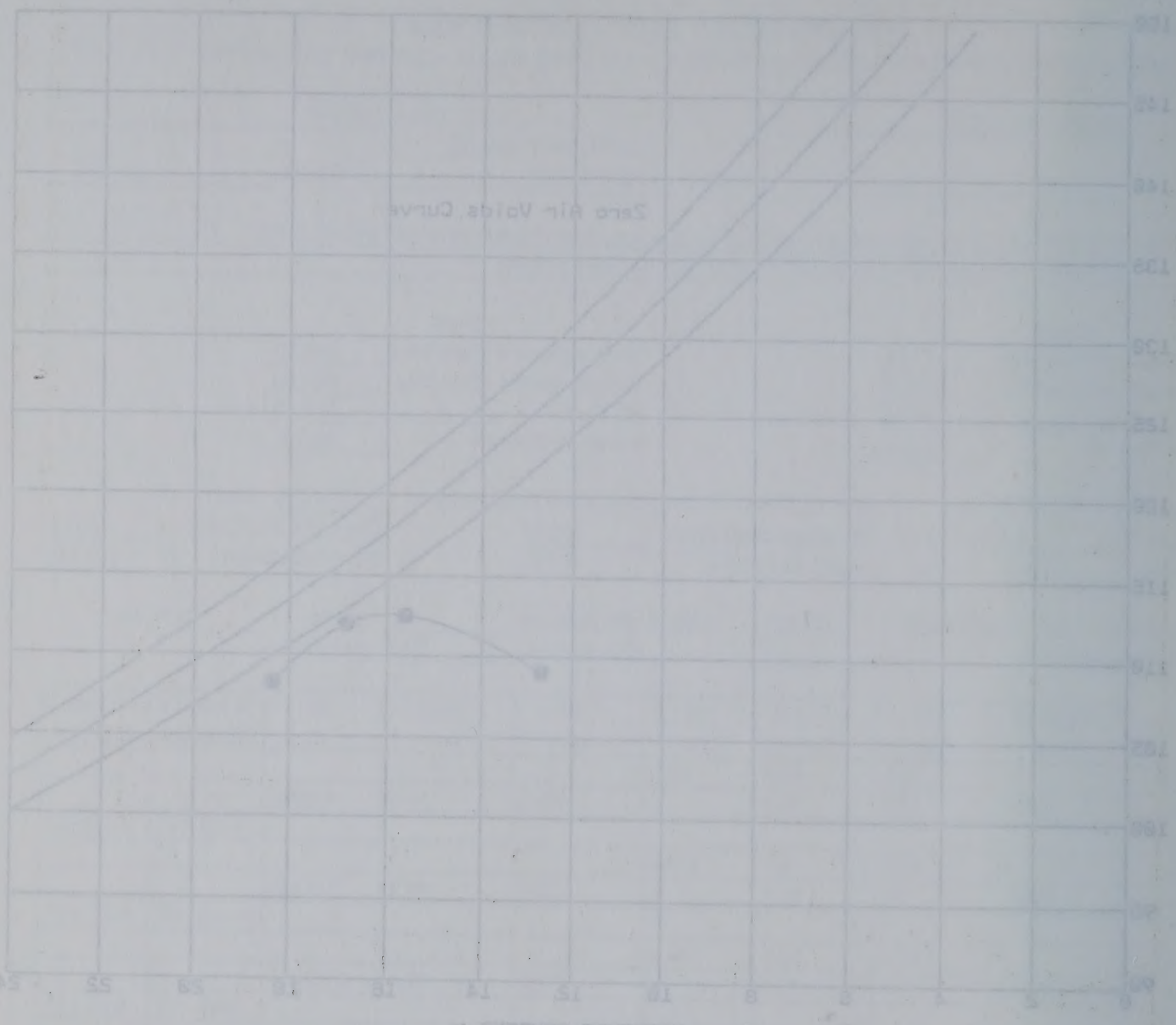
Job No: BHDX-92-212L
Appr:
Date: NOV 2, 1992

MOISTURE-DENSITY CURVE (PROCTOR)

Helena Landfill
Helena, Montana

Braun Intertec Engineering, Inc., Billings, Montana

PLATE
P-1



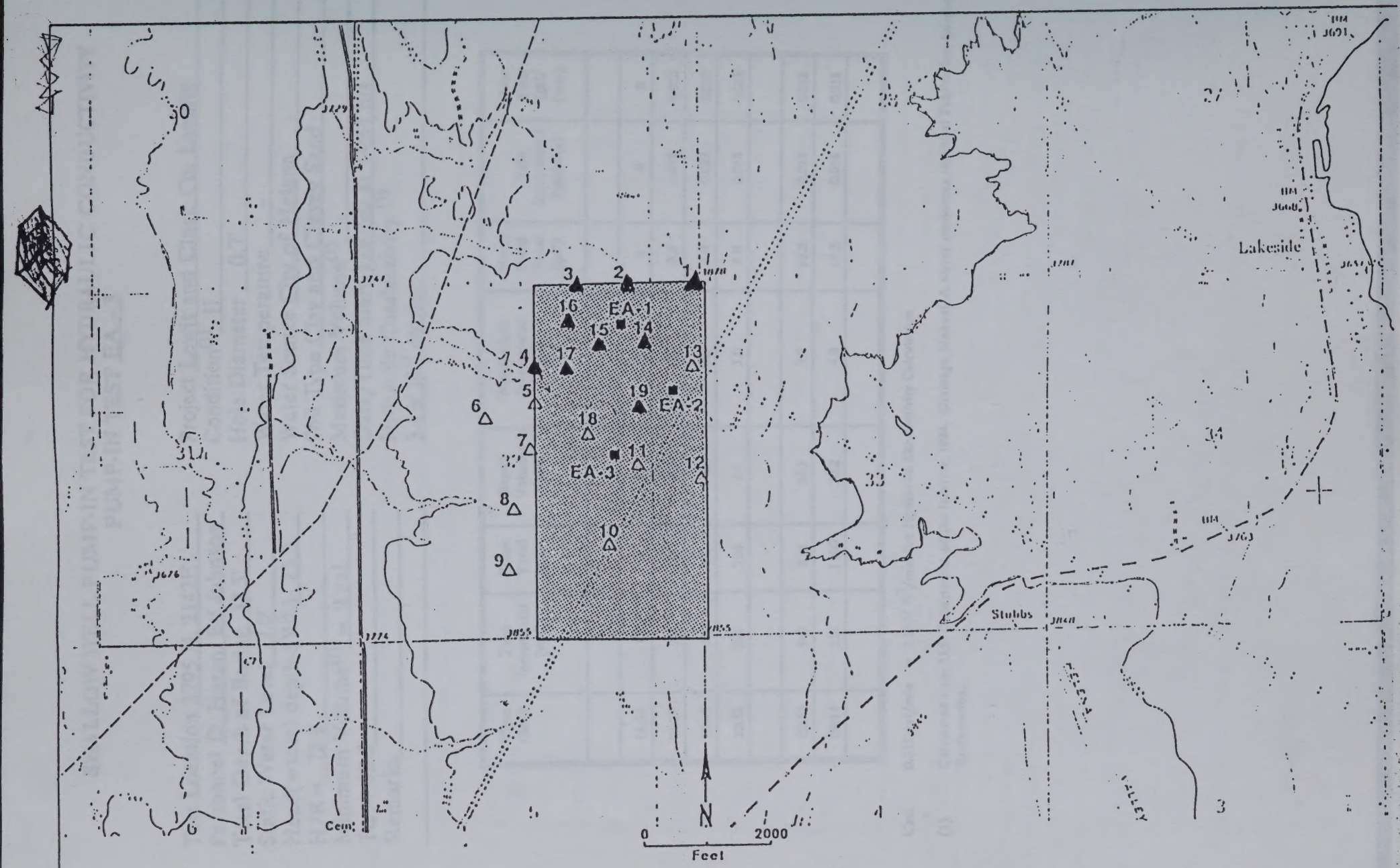
MOISTURE-DENSITY CURVE (PROCTOR)

Helena Landfill
Helena, Montana

Braun Intertec Engineering, Inc., Billings, Montana

PLATE

P-1



△ Test Pit Location

■ Geotechnical Boring

Location of the Test Pits and Geotechnical Borings
Lewis and Clark County Landfill Site, Montana

FIGURE 2-5

SHALLOW WELL PUMP-IN TEST FOR HYDRAULIC CONDUCTIVITY
PUMP-IN TEST EA - 3

Test Location 3795 N, 2142E
Personnel D. Hazen, Ed Johnson
Total Depth of Boring 32.5'
Static Water Level 7.0'
Head(=total depth-SWL) 25.5
H/R= 72.9
Minimum Volume[1] ≈ 9 gal
Tu = 32.5
Remarks

Project Lewis and Clark Co. Landfill
Condition[1] II
Hole Diameter 0.7'
Water Temperature -
Water Source City of Helena
Soil Type Clay and Clayey Sand
Maximum Volume[1]
Date/Time Start 1/8/90 at 14:54 hrs
Hydraulic Conductivity [1]
3.4×10^{-7} cm/sec

Time of Clock	Time Incremental (min)	Time Total (min)	Barrel Volume (gal)	Water Used Incremental (gal)	Water Used Total (gal)	Rate Incremental (gal/min)	Rate Total (gal/(min)
14:54	0	0	50	0	0	0	0
15:27	33	33	49.5	0.5	0.5	0.015	0.015
15:45	18	51	49	0.5	1.0	0.028	0.020
20:30	285	336	44	5.0	6.0	0.018	0.018
05:30	540	876	34.5	9.5	15.5	0.018	0.018
09:14	224	1100	30.2	4.0	19.5	0.018	0.018

Use: 0.018 gal/min = 0.0024 ft^3/min for Hydraulic Conductivity Calculation

(1) Calculated from U.S. Department of the Interior, 1984. Drainage Manual. A water resources technical Publication, Bureau of Reclamation.

SHALLOW WELL PUMP-IN TEST FOR HYDRAULIC CONDUCTIVITY
PUMP-IN TEST EA - 2

Test Location 4659 N, 3164E
Personnel D. Hazen, Ed Johnson
Total Depth of Boring 34.0'
Static Water Level 5.5'
Head(=total depth-SWL) 28.5
H/R= 81.4'
Minimum Volume[i] ≈ 9 gal
Tu = 34.0
Remarks

Project Lewis and Clark Co. Landfill
Condition[1] II
Hole Diameter 0.7
Water Temperature -
Water Source City of Helena
Soil Type Clay and Clayey Sand
Maximum Volume[i]
Date/Time Start 1/9/90 at 10:53 hrs
Hydraulic Conductivity [1]
1.2×10^{-7} cm/sec

Time Clock	Time Incremental (min)	Time Total (min)	Barrel Volume (gal)	Water Used Incremental (gal)	Water used Total (gal)	Rate Incremental (gal/min)	Rate Total (gal/min)
10:53	0	0	51.0	0	0		
14:11	198	198	49.3	1.7	1.7	0.0086	0.0086
16:35	144	342	48.0	1.3	3.0	0.009	0.0088
20:07	212	554	46.75	1.25	4.25	0.006	0.0077
06:00	593	1147	42.25	4.5	8.75	0.0076	0.0076
08:52	172	1319	41.0	1.25	10.0	0.0073	0.0076

Use: 0.0076 gal/min = 0.001 ft^3/min for Hydraulic Condcutivity calculation

(1) Calculated from U.S. Department of the Interior, 1984. Drainage Manual, A water resources technical Publication, Bureau of Reclamation.

SHALLOW WELL PUMP-IN TEST FOR HYDRAULIC CONDUCTIVITY
PUMP-IN TEST EA - 1

Test Location 5669 N, 2461E
Personnel D. Hazen, Ed Johnson
Total Depth of Boring 34.0'
Static Water Level 4'
Head(=total depth-SWL) 30'
H/R= 85.7'
Minimum Volume[1] ≈ 9 gal
Tu = 34.0
Remarks

Project Lewis and ClarkCo.Landfill
Condition[1]II
Hole Diameter 8.3/8", 0.7'
Water Temperature -
Water Source City of Helena
Soil Type Clay with fine sand, clayey sand
Maximum Volume[1]
Date/Time Start 12/7/89 at:17hrs
Hydraulic Conductivity [1]
6.8×10^{-7} am/sec

Time Clock	Time Incremental (min)	Time Total (min)	Barrel Volume (gal)	Water Used Incremental (gal)	Water Used Total (gal)	Rate Incremental (gal/min)	Rate Total (gal/min)
15:17	0	0	48	0	0		
16:00	43	43	47.2	0.8	0.8	0.019	0.019
21:03	303	346	36.5	10.7	11.5	0.035	0.033
6:11	548	894	11.0	25.5	37.0	0.046	0.041

Use: 0.045 gal/min = 0.006 ft^3/min for Hydraulic Conductivity Calculation

(1) Calculated from U.S. Department of the Interior, 1984. Drainage Namual, A water resources technique Publication, Bureau of Reclamation.

APPENDIX D.

TOPSOIL DATA


238B
263E
306A
433E
514B
501B
149D
808A
308A
538C
20A
LANDFILL
AREA
32
233C
5
533B
39B
406A
513A
ROAD
33B
Borrow
Area
VEFW-1-25-N
DRIVE



204 -- Weingart-Assinniboine complex, 2 to 8 percent slopes

Composition

* Weingart and similar soils: 50 percent

* Assinniboine and similar soils: 40 percent

Contrasting soils: 10 percent

Setting

Location in survey area: mainly southern part

Landform: uplands

Position on landform:

* Soils are too intricately mixed for position description

Slope range:

* Weingart - 2 to 8 percent

* Assinniboine - 2 to 8 percent

Elevation: 3800 to 4500 feet

Mean annual precipitation: 10 to 14 inches

Frost-free period: 105 to 120 days

Typical Profile

Weingart soil

0 to 7 inches - [illegible] loam [illegible] loam when mixed 0 to 7 inches)

[illegible]

17 to 30 inches - pale brown clay

30 to 60 inches - pale yellow silty loam

30 to 60 inches - [illegible] pale yellow to white semiconsolidated loamy sedimentary beds

Assiniboine soil

0 to 5 inches - grayish brown sandy loam

5 to 9 inches - grayish brown sandy clay loam

9 to 14 inches - pale brown sandy clay loam

14 to 36 inches - white sandy loam

36 to 60 inches - light gray sandy loam

Soil Properties and Qualities

Weingart soil

Depth class: moderately deep

Drainage class: well drained

Parent material: sources - shale and semiconsolidated sedimentary beds

Subsoil: moderately sodic

Salinity: moderately saline at 17 to 30 inches

Permeability: very slow

Available water capacity: mainly 5 inches

Runoff: medium

Assiniboine soil

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Inclusions

* soils that have slopes of more than 6 percent

* soils that have loam texture throughout the profile

* soils that are moderately deep and clayey throughout the profile

* moderately deep soils with a sandy loam surface, and a sand clay loam subsoil

Uses of the Unit

Major current uses:

* irrigated cropland

* nonirrigated cropland

Cropland

Commonly grown crops:

* nonirrigated - spring wheat, winter wheat, barley

* irrigated - spring wheat, barley, alfalfa hay, grass-legume hay, pasture

Aeingart soil

[illegible]

[illegible] and irrigated

[illegible]

[illegible]

* [illegible] to water

* [illegible] to the perching

* [illegible] to semiconsol. dated sedimentary beds and shale

* poor [illegible]

* salt content

* Sodium content

* soil [illegible]

* surface crusting

* [illegible] available water capacity

Assiniboine soil

Capability classification:

* IVe, nonirrigated

* IVe, irrigated

Main soil limitations and hazards:

* soil blowing

* erosion by water

Rangeland

Weingart soil

[illegible]

Assiniboine soil

[illegible]

Windbreaks

Weingart soil

[illegible]

Assiniboine soil

[illegible]

34 -- Crago-Musselshell gravelly loams, 4 to 35 percent slopes

Composition

Crago and similar soils: 35 percent

Musselshell and similar soils: 40 percent

Included: 10 percent

Setting

Location in survey area: mainly southern part

Landforms: fan terraces, stream terrace edges, footslopes of uplands

Position on landform:

* soils are too intricately mixed for position description

Slope ranges:

* Crago soil - 4 to 35 percent

* Musselshell soil - 4 to 35 percent

Elevation: 3600 to 5000 feet

Mean annual precipitation: 10 to 14 inches

Frostfree period: 105 to 120 days

Typical Profile

Crago soil

0 to 4 inches - light brownish gray gravelly loam

4 to 32 inches - white very gravelly loam

32 to 60 inches - very pale brown extremely gravelly sandy loam

Musselshell soil

0 to 4 inches - grayish brown gravelly loam

4 to 24 inches - light gray to pale brown gravelly loam

24 to 34 inches - white very gravelly sandy loam

34 to 60 inches - very pale brown gravelly loam

Soil Properties and Qualities

Crago soil

Depth class: very deep

Drainage class: well drained

Parent material: alluvium from limestone

Permeability: moderate

Available water capacity: mainly 4.0 inches

Runoff: rapid

Musselshell soil

Depth class: very deep

Drainage class: well drained

Parent material: alluvium from limestone

Permeability: moderate

Available water capacity: mainly 6 inches

Runoff: rapid

Inclusions

* Soils that have slopes of more than 35 percent
* Soils that have a subsoil of silty loam surface layer
* Soils that have bedrock at a depth of 10 to 20 inches
* Soils that are loam or clay loam throughout the profile

Uses of the Unit

Major current uses:

* rangeland

Cropland

Commonly grown crops:

* nonirrigated - none

Crago

Capability classification:

* VIe, nonirrigated

Main soil limitations and hazards:

* soil blowing
* erosion by water
* slope
* limited available water capacity
* surface coarse fragments
* lime content

Musselshell

[illegible]

[illegible]

[illegible]

* slope

* erosion by water

* stone

* surface coarse fragments

* lime content

Rangeland

Crago and Musselshell soils

Range site:

* Silty--imy phase, 10- to 14-inch precipitation zone

Windbreaks

Crago and Musselshell soils

Windbreak suitability group - 4 to 15 percent slopes:

* 2L

Windbreak suitability group - 10 to 25 percent slopes:

* 1

APPENDIX E.

METHANE INFORMATION

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-735-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 91-26557
DATE: 08/02/91 da

NATURAL GAS ANALYSIS REPORT

Helena Landfill
HL9107-1A
Sampled 07/23/91 @ 0930
Submitted 07/25/91

CHROMATOGRAPH ANALYSIS

Constituent	Volume, %
Oxygen	20.86
Nitrogen	77.72
Carbon dioxide	1.12
Hydrogen Sulfide	
Methane	0.30
Ethane	0.00
Propane	0.00
Isobutane	0.00
N-Butane	0.00
Isopentane	0.00
N-Pentane	0.00
Hexanes plus	0.00
Totals	100.00

APPENDIX E.

METHANE INFORMATION

Dear Sir:

The following letter is to inform you of a condition at and peripheral to the City of Helena Landfill. During the natural breakdown of landfilled refuse, methane gas is formed. This methane can create explosive conditions and a low oxygen environment in sub-grade structures and excavations. Even though the levels of methane do not appear to be of concern in the landfill area, the City of Helena believes you should be aware of the potential problem and exercise precautionary measures when servicing any underground utilities or excavating in the vicinity of the landfill.

In the recent past, the City has monitored and sampled in numerous areas in and near the landfill. The results indicate that methane concentrations in monitoring wells and structures are well below the lower explosive limit and that these low concentrations of methane diminish a short distance from the landfilled area. However, we recommend monitoring oxygen and methane levels in any excavations, or when working in any sub-grade structures in or directly adjacent to the City landfill.

The City of Helena Fire Department is continuing to closely monitor this situation and should you have any questions we would be glad to be of assistance.

Sincerely,

Richard Nisbet, P.E.
Director of Public Works

RN:kab

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-873-5227

LABORATORY REPORT

TO: Hydrometrics
ADDRESS: Steve Downs
2727 Airport Road
Helena, MT 59601

LAB NO.: 91-26557
DATE: 08/02/91 da

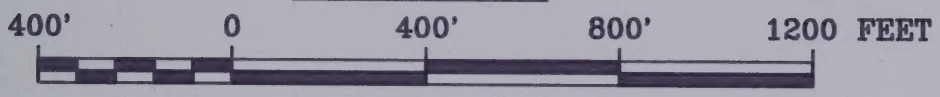
NATURAL GAS ANALYSIS REPORT

Helena Landfill
HL9107-1A
Sampled 07/23/91 @ 0930
Submitted 07/25/91

CHROMATOGRAPH ANALYSIS

Constituent	Volume, %
Oxygen	20.86 21
Nitrogen	77.72 78
Carbon dioxide	1.12 1.
Hydrogen Sulfide	
Methane	0.30
Ethane	0.00
Propane	0.00
Isobutane	0.00
N-Butane	0.00
Isopentane	0.00
N-Pentane	0.00
Hexanes plus	0.00
Totals	100.00

Scale



Project:

City of Helena Landfill

Sheet Title:

Domestic and Monitoring Well Locations and Potentiometric Contour Map for Spring, 1992

Drawn: GLF, JHD
Checked: SD
Approved: MW
Date: 7/20/92
Rev. 4/9/93

Hydrometrics, Inc.
Consulting Scientists and Engineers
2727 Airport Road
Helena, Montana 59601
(406) 443-4150

EXHIBIT 1

HLF2392F


SILSBEE RD
REED RD
WILLOW RD
DUNBAR RD
BARNEY ST
PARRYAN ST
PAYON ST
RUSSELL LN
CUSTER AVENUE
BRADY ST
OVAL J ST
LARSON ST
HARTLEY
MEADOW DR
GREENWOOD DR
ANDERSON BLVD
OAKWOOD LN
WEDGEWOOD LN
VALLEY DR
WAREHOUSE
HUDSON ST
WAUKESHA AVE
PEOSTA AVE
HOLLINS AVE
DELTA AVE
WILDER AVE
EUCLID AVE
BENTON AVE
BILL ROBERTS MUNICIPAL GOLF COURSE
BATCH FIELDS
ELK RIVER CONCRETE
MONTANA RAIL LINK
LANDFILL OFFICE
CARROLL COLLEGE
RALPH ST
HENRY ST
PARK AVE
FRONT ST
3880
HL90-1
HL90-2
HL90-3
82-4
82-3
EPA4
HL-1
83-5
83-6
(3978.07)
I-1
I-2
I-3
I-4
I-5
I-6
R4W
R3W



NORTH

Legend

- HL-2 ■ Piezometer
- 83-5 Abandonded Monitoring Well
- 83-6 ● Monitoring Well
- I-6 ▲ Irrigation Well
- 80 ⊙ Domestic Well
- Infiltration Gallery
- 3950 Potentiometric Contour (May, 1992) (Dashed Where Inferred)
- Approx. Location Of Storm Drain
- Approx. Extent Of City Of Helena Landfill

Scale

400' 0 400' 800' 1200 FEET

Project:

City of Helena Landfill

Sheet Title:

Domestic and Monitoring Well Locations and Potentiometric Contour Map for Spring, 1992

Drawn: GLF, JHD
Checked: SD
Approved: MW
Date: 7/20/92
Rev. 4/9/93

Hydrometrics, Inc.
Consulting Scientists and Engineers
2727 Airport Road
Helena, Montana 59601
(406) 443-4150

EXHIBIT 1

HLF2392F

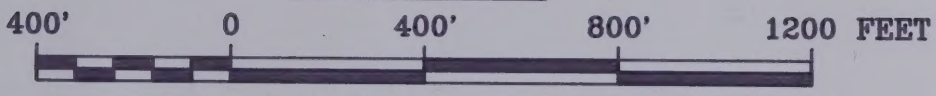
Approx. Location of storm drain

Approx. Extent of City of Helena Landfill

Approx. Location Of Storm Drain

Approx. Extent Of City Of Helena Landfill

Scale



Project:

City of Helena Landfill

Sheet Title:

Approximate Extent Of Dichlorodifluoromethane In Groundwater – Spring 1992

Drawn: GLF, JHD
Checked: SD
Approved: MW
Date: 7/27/92
Rev.: 11/03/92

Hydrometrics, Inc.
Consulting Scientists and Engineers
2727 Airport Road
Helena, Montana 59601
(406) 443-4150

EXHIBIT 2

HLF2492F


SILSBEE RD
REED RD
WILLOW RD
DUNBAR RD
BARNEY ST
PAXTON ST
CUSTER AVENUE
COONEY DR
BRADY ST
OVAL J ST
LARSON ST
HARTLEY
SUNHAVEN LN
KEVEN
MICHAEL
DAVID
REBECCA
DEBORAH
KENYON
MEADOW DR
GREENWOOD DR
ANDERSON BLVD
POTTER DR
CAPITAL
OAKWOOD LN
WEDGEWOOD LN
RIDGEWOOD LN
VALLEY DR
MONTANA RAIL LINK
BILL ROBERTS MUNICIPAL GOLF COURSE
BATCH FIELDS
ELK RIVER CONCRETE
BENTON AVE
CARROLL COLLEGE
WAREHOUSE
HUDSON ST
WAUKESHA AVE
PEOSTA AVE
HOLLINS AVE
LESLIE AVE
WILDER AVE
EUCLID AVE
LINDEN ST
LAUREL ST
GLENDALE ST
CAMERON ST
MOUNTAIN ST
HENDERSON ST
MADISON ST
CLEVELAND ST
GRANT ST
LINCOLN ST
GARFIELD ST
JEFFERSON ST
RALPH ST
HENRY ST
PARK AVE
KESSLER ST
GETCHELL ST
FRONT ST
HL90-1
9.1
HL90-3
<1.0
HLP91-1
82-4
82-3
EPA4
HL-2
HL-1
83-5
83-6
<1.0
R4W
R3W



NORTH

Legend

- HL-2 ■ Piezometer
- 83-5 ○ Abandoned Monitoring Well
- 83-6 ● Monitoring Well
- I-6 ▲ Irrigation Well
- 80 ▣ Domestic Well
- Infiltration Gallery
- 3950 — Potentiometric Contour (Dashed Where Inferred)
- 2.9 Concentration of Dichlorodifluoromethane Parts Per Billion (ppb) (Isoconcentration Line Dashed Where Inferred)
- 1.0 – 4.0 Dichlorodifluoromethane
- 4.0 – 10.0 Dichlorodifluoromethane
- >10 Dichlorodifluoromethane
- Approx. Location Of Storm Drain
- Approx. Extent Of City Of Helena Landfill

Scale

400' 0 400' 800' 1200 FEET

Project:

City of Helena Landfill

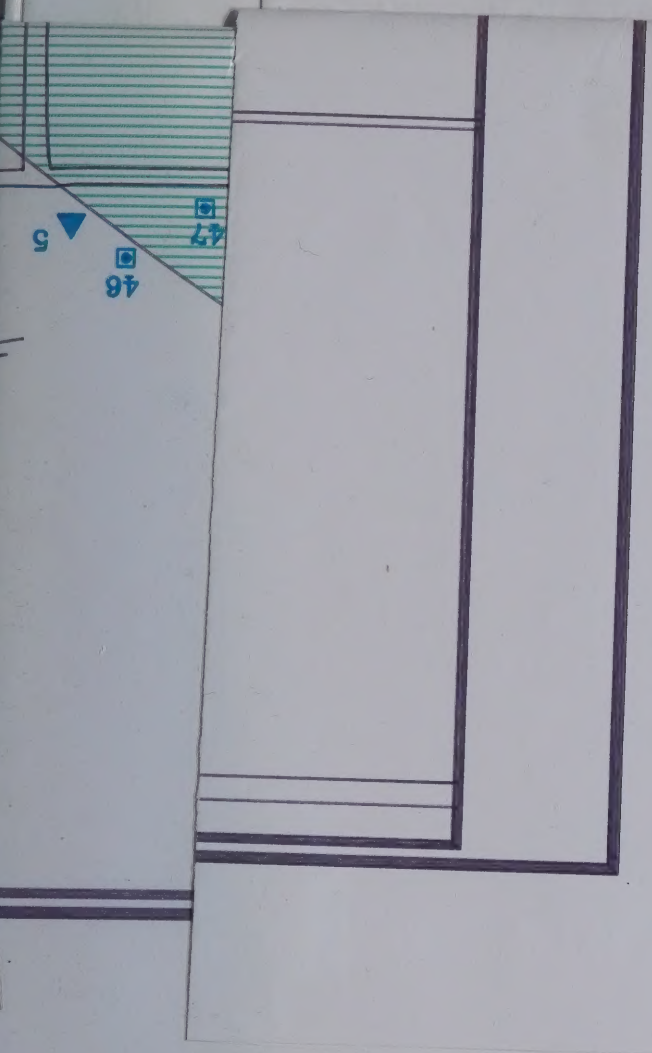
Sheet Title:
Approximate Extent Of Dichlorodifluoromethane In Groundwater – Spring 1992

Drawn: GLF, JHD
Checked: SD
Approved: MW
Date: 7/27/92
Rev.: 11/03/92

Hydrometrics, Inc.
Consulting Scientists and Engineers
2727 Airport Road
Helena, Montana 59601
(406) 443-4150

EXHIBIT 2

HLF2492F



Potentiometric Contour
(Dashed Where Inferred)

2.9 Concentration of Dichlorodifluoromethane Parts Per Billion (ppb) (Isoconcentration Line Dashed Where Inferred)

1.0 – 4.0 Dichlorodifluoromethane

4.0 – 10.0 Dichlorodifluoromethane

>10 Dichlorodifluoromethane

Hydrometrics, Inc.
2727 Airport Road • Helena, Montana 59601 • (406) 443-4150 • FAX (406) 443-4155

April 8, 1993

RECEIVED
APR 0 9 1993
MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES

Mr. James Wilbur
MT Dept. Health and Env. Sciences
Solid Waste Program
Cogswell Building
Helena, Montana 59620

RE: Helena Landfill Drainage Channel Design

Dear Jim:

Enclosed for the MDHES' review is the "Revised Helena Landfill Closure Plan" this plan incorporates the changes which the MDHES requested in thier comments on the original closure plan as well as addresses the additional cover requirements of Subtitle D. The revised sections of the plan have been redlined to assist you during your review. As you know, the City is committed to closing the landfill this summer, so please contact us at any time during your review if we can answer any questions which may help expidite the review process.

Thank you for your continued cooperation on this project. If you have any questions, please call anytime.

Sincerely,

Steven K. Downs
Senior Engineer

c: Mr. Dick Nisbet, City of Helena, Public Works Director
Mr. Ted Hill, City of Helena, Environmental Engineer

u:\sdowns...letters\wilbur2.skd

File CDBG AND Helena I.F. Closure

DEPARTMENT OF ENVIRONMENTAL QUALITY

MARC RACICOT, GOVERNOR

STATE OF MONTANA

(406) 444-2544

PO BOX 200901
HELENA, MONTANA 59620-0901

(406)-444-5263

December 30, 1998

Put - Info - Tom

County L+C
Facility & # Helena 90
Closure
Finan Assur
GW Corr Meas
GW Monitoring
GW Reports
Inspections
Other:
Landfarm
Liner
Methane
O & M
Run - On

Lewis and Clark County
Attn: Randy Lilje
City/County Building
316 North Park
P.O. Box 1724
Helena, MT 59624

Dear Mr. Lilje:

RE: CTEP Funded Bicycle-Pedestrian Path Project

The environmental health considerations administered by the Montana Department of Environmental Quality (DEQ) have been reviewed for a proposal by Lewis and Clark County to use Community Transportation Enhancement Program (CTEP) and Simms Recreational Trails Program funds for the creation of a bicycle-pedestrian path project through Nature Park to connect with North Main and Benton Avenue.

Water Quality

The Montana Pollutant Discharge Elimination System General Discharge Permit for Storm Water Associated with Construction Activity applies to all areas of the State of Montana except Indian Reservations.

The permit regulates the discharge of pollutants associated with construction activities in storm water to state surface waters. Discharge of pollutants means *any addition of any pollutant or combination of pollutants to state waters from any point source.* Sediment is a *pollutant*, as are oil and grease, fuels, fertilizers, etc. Storm water means *storm water runoff, snow melt runoff, and surface runoff and drainage.* State waters means *any body of water, irrigation system, or drainage system, either surface or underground.*

The permit covers construction activities including clearing, grading, and excavating of a total of five (5) or more acres that is a part of a common plan for development or sale or greater than one acre of contiguous clearing, grading and excavating, any part of which is located within one hundred (100) feet of state waters.

A proposed construction project that meets the above criteria must submit to the PCD (444-5329) an application for coverage under the general discharge permit, a site-specific erosion control plan, and the appropriate application fee at least thirty (30) days prior to construction taking place.

Solid Waste

The following is a summary of comments and recommendations regarding possible solid and hazardous waste considerations:

- All Group II material generated during the project, such as waste insulation, plastic, and metal, should be reused, recycled, or disposed of in a licensed Class II (municipal) landfill or incinerator. The Lewis and Clark County Class II Landfill could accept waste from this project without significantly impacting its normal operating procedures or the environment. The Permitting and Compliance Division (PCD) recommends getting the operator's approval before taking material to any disposal site.

- Untreated wood waste and rebar-free concrete are considered Group III material and should be reused, recycled, or disposed of in either a licensed Class II landfill.

- Untreated wood waste and brush generated during this project could also be composted.

- Clean fill, such as soil, dirt, sand, gravel, rocks, and rebar-free concrete leftover from a project does not have to be placed in a licensed Class II or III landfill if it is emplaced free of charge to the person placing the fill. The clean fill has to be used to adjust or create topographic irregularities for agricultural or construction purposes (ARM 16.14.502(6)).

- Caution is advised if buried material is found during the project, as the material might be hazardous. If such a situation arises, the PCD should be contacted immediately.

- For safety purposes, the applicant should consider a contingency plan outlining how the applicant will handle potential situations where unknown material is found, who should be called, personal protection, appropriate response, etc.

If you have questions, please call: Fred Shewman, Water Protection Bureau, PCD, 444-5329, or Pat Crowley, Community Services Bureau, PCD, 444-5294.

Sincerely,

Tom Ellerhoff

Tom Ellerhoff
Administrative Officer

cc: Director's Office
E. Hedlund, MDOT

92-16

RECEIVED
NOV 13 1997
MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

MEMORANDUM

MAY 2, 1997

TO: **CHUCK HANSON, CITY ENGINEER**

FROM: **DOUG KREBS, ENGINEERING MANAGER**

SUBJECT: **CITY OF HELENA FINAL LANDFILL CLOSURE PLAN**

Hydrometrics, Inc. submitted the Helena Landfill Closure Plan to the Montana Department of Health and Environmental Sciences in September 1991. Hydrometrics, Inc. designed the Closure Plan to meet all requirements set forth by the State of Montana in the Administrative Rules of Montana, Title 16, Chapter 14-Solid Waste Management, Sub-chapter 5-Refuse Disposal; and Sub-chapter 7-Proposed Groundwater Monitoring Rules for Landfills in Montana.

The engineer designed the final cover for the City of Helena Landfill according to the State of Montana Class II Landfill Closure Requirements and Recommendations (April 3, 1991). Proposed future land use, maintenance and monitoring have all been considered in the final cover design.

Maronick Construction completed the final cover elevations corrections resulting from DEQ's spring of 1994 on site inspection in October 1995. The chronological sequence of the engineering staff involvement is on file in the engineering office.

10-24-95 Completed Final Cover (Maronick Const.)
9-26-95 Bluetopped ditch on So. side
9-7-95 Met w/ Gene & John of Helena Sand (Maronick) & discussed scheduling of final cover for Landfill

5-19-94 Met w/ Dale from SK const. & discussed remaining cover needed
5-18-94 Field work measuring stock pile & later staff meeting to discuss remaining cover
5-10-94 Ritchie worked on RCRA dwg for final cover
5-9-94 measured slopes for seeding quantities

4-21-94 Staked ditch on So. Side
4-18-94 Began Total Sta. Surv. of Landfill
4-14-94 Calc'd quantity hauled from Site E
4-11-94 Began Staking final cover
1-19-94 Began Plotting X-Sec. Site E
1-4-94 Met / HH, Willie concerning Scott Prindles claim
11-16-93 X-Sec. Site E. — Staked ditch on no-side Landfill
11-4-93 X-Sec Top of Clay

Does this mean that the street dept. & we met & they agreed not to dig any more test holes & that they would not dig any more test holes for us?

5-25-94 Met w, John Ungaffe concerning prop. trade for Mt
5-26-95 Met w/ Jon Stefferk & discussed Ungaffre

10-28-93 Staked top of clay
10-27-93 Met w/ Scott Prindle, Doug & Erick & discussed problem w/ the $3.50 /yd. price
10-21-93 Showed Leroy of Sanitation where to work on Slopes
10-13-93 Met w/ Will Selesen, Griffith, Hansen, Prindle Erics about Leroy Heather not completing contract
7-21-93 Staked top of Garbage w/ Packer

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MEMORANDUM

TO: Dick Nisbet

FROM: Bill Michalson BM

RE: Clay Cover Over Transfer Station Site

DATE: May 17, 1993

On Wednesday, May 12th, I met with Laura Dando of the State Solid and Hazardous Waste Bureau and excavated test holes to determine the depth of the clay cover. We drilled fourteen test holes, concentrating our efforts in the area that will be paved in the future. The access road that encompasses the entire site had approximately 4" too much clay. The interior roads leading in and out of the transfer station itself are covered with 18"-19" of clay.

I suggest that elevations be shot and staked for the actual road grade that encompasses this site and any additional material be moved to the ditch on the east side - as this is lacking in cover material. Any excess material should be worked up to the east slope over the area requiring 24" of clay cover.

cc: Doug Krebs
Frank Ritchie

Chen Northern, Inc.

Consulting Engineers & Scientists

MOISTURE-DENSITY RELATIONSHIP DATA SHEET

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COMMUNITY SERVICES BUREAU

☐ HELENA
1610 B STREET
P. O. BOX 4699
HELENA, MT 59604
(406) 443-5210
FAX (406) 449-3729

REPORT TO: City of Helena
Attn: Mr. Doug Krebs, P.E.
316 North Park
Helena, MT 59623

DATE: May 13, 1993
JOB NUMBER: 93-3481
SHEET: 1 OF 1
INVOICE NO.: 127771
LAB NO.: 11694
DATE SAMPLED: 05-03-93
DATE RECEIVED: 05-03-93
SAMPLED BY: E. Johnson

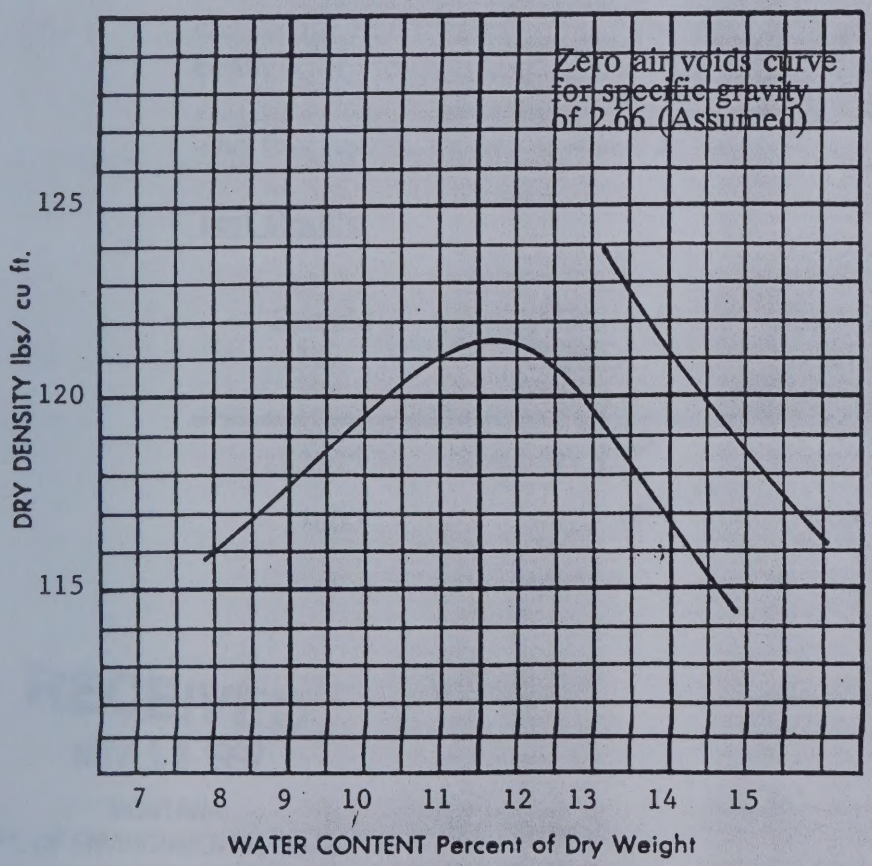
PROJECT: City of Helena Landfill
CONTRACTOR: N/R
SAMPLE LOCATION: West End

MATERIAL USE: Cover Material

MECHANICAL ANALYSIS

SIZE	% PASS	SPECS.
NOT PERFORMED		

MOISTURE-DENSITY RELATIONSHIP



UNIFIED CLASSIFICATION (ASTM D2488)
Clayey Sand with Gravel
SPECIFIC GRAVITY: 2.66 (Assumed)
LIQUID LIMIT: Not Performed
PLASTICITY INDEX: Not Performed

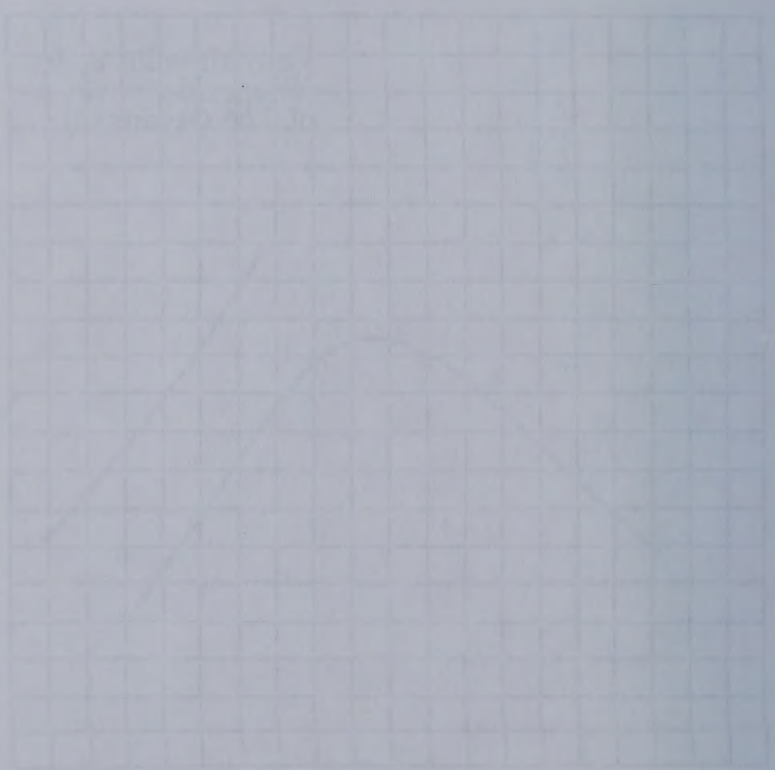
TEST PROCEDURE ASTM D698-B
MAX. DENSITY: 121.6 pcf
OPT. MOIST.: 11.7%
RAMMER TYPE: Manual
PREPARATION PROCEDURE: Wet
PENETRATION RESIS.: N/A

REMARKS:

DISTRIBUTION:

Reviewed By: Jeremiah B. Bowser

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Chen-Northern Inc.

A member of the HIH group of companies

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P. O. BOX 4699
HELENA, MT 59604
(406) 443-5210
FAX (406) 449-3729

TECHNICAL REPORT

REPORT TO: City of Helena
Attn: Mr. Doug Krebs, P.E.
316 North Park
Helena, MT 59623

DATE: May 11, 1993
JOB NUMBER: 93-3481
SHEET: 1 **OF** 1
INVOICE NO.: 127768

REPORT OF: Laboratory Analysis of Soils, City of Helena Landfill

SAMPLE IDENTIFICATION:

On April 12 and 16, 1993 our personnel sampled soil imported from site "E" landfill for use as cover material at the City of Helena landfill. We performed moisture-density one point checks for determining the appropriate ASTM D698 curve used for performing hydraulic conductivity tests in accordance with ASTM D5084.

The test results are summarized as follows:

Test Results

Sample No.	Dry Density (pcf)	Moisture Content, (%)	Hydraulic Gradient	Hydraulic Conductivity (cm/sec)
11595	91.6	16.8	18.46	5.9×10^{-6}
11600	82.5	23.6	18.46	9.9×10^{-7}

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Reviewed By: Jeremiah B. Bowser

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(Rev. 1/89) CNI-114

Chen-Northern Inc.

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1610 B STREET
P. O. BOX 4699
HELENA, MT 59604
(406) 443-5210
FAX (406) 449-3729

TECHNICAL REPORT

REPORT TO: City of Helena
Attn: Mr. Doug Krebs, P.E.
316 North Park
Helena, MT 59623

DATE: May 17, 1993
JOB NUMBER: 93-3481
SHEET: 1 OF 2
INVOICE NO.: 127772

REPORT OF: Tests of compacted cover material for City of Helena Landfill; Helena, MT

SAMPLE IDENTIFICATION:

Attached are the results of field density tests performed on the above-referenced project on the dates and at the locations shown. Unless otherwise noted, our personnel utilized the nuclear densometer method of testing in accordance with ASTM D2922. In accordance with our quality control procedures, occasional routine correlation tests are performed using sand cone methods in accordance with ASTM D1556.

Contractor:

Test Locations were selected by: Chen-Northern personnel at random locations

Minimum required in-place density: 85% of the Maximum Laboratory Density

Maximum density as determined by:* ASTM D698

Remarks:

Reviewed By: Jeremiah B. Bowser

Distribution:

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City of Helena
Attn: Mr. Doug Krebs, P.E.
316 North Park
Helena, MT 59623

May 17, 1993
93-3481
Sheet 2 of 2
127772

City of Helena Landfill; Helena, MT

TEST RESULTS:

Test Date	Lab No.	Field Moisture Content, %	Field Dry Density, pcf	Maximum Lab Dry Density, pcf	Percent of Maximum Obtained
05-03-93	**11680**	10.6	118.7	121.6[a]	97.6
Southwest corner area, first lift					
05-03-93	**11681**	10.6	122.1	121.6[a]	100.4
Center of North end, first lift					
05-03-93	**11682**	14.0	108.4	121.6[a]	89.1
Northeast corner area, first lift					
05-03-93	**11683**	12.1	110.8	121.6[a]	91.1
Southeast corner area, first lift					
05-03-93	**11684**	10.4	121.1	121.6[a]	99.6
Center of South end, first lift					

(a) MD Curve No. 11694 (Maximum Density 121.6 pcf and Optimum Moisture 11.7%)

Chen Northern, Inc.

PROJECT REPORT

Project City Landfill Job No. 93-3481

Client City of Helena Date 05-03-93

Contractor _____ Report No. _____

Feature _____ Sheet _____ of _____

Weather _____ Min. Temp. _____ Max. Temp. _____ Work Period 3:00 A.M. P.M. to 4:30 A.M. P.M.

Personnel	Position	Mileage	Total Hours
E. Johnson	CET		

NARRATIVE

- Performed 5 in-place field density tests on 1st lift of Fill material imported from site "E") for use as cover material City of Helena Landfill. In-place Dry Density values were lighter than those on the M-D curves supplied from site "E". Dry Density results were significantly lighter on ~~East~~ West end of landfill. One soil sample was taken on West end for testing a new M-D determination.

Preliminary observations and/or Test Results verbally reported to: _____

Approved _____ Date _____ Prepared By _____

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Methane
G.W. Corr
Measures

MEMORANDUM

TO: Unofficial Sports Council Members
Centennial Park Stakeholders

FROM: Randy Lilje, Director of Parks and Recreation

RE: **Meetings on Sports Fields Plans**

DATE: September 5, 1997

The sports council and Centennial Park stakeholders will be meeting **Thursday, September 11 at noon at the Mae Butler Center conference room, 55 South Rodney.** The meeting will be to discuss Carl Thuesen's preliminary master plan for Centennial Park, the preliminary plan for Northwest Park, and Helena Youth Soccer Association's plans for the complex on the airport grounds. Please bring the most recent draft of the Centennial Park plan.

ALSO, please mark your calendars now for a meeting with Carl Thuesen on **Thursday, September 18, 7 P.M., room 326 of the City-County Building.** This will be a public meeting where Carl will discuss his work to this point.

If you have any questions or concerns, you can reach me at 447-8463.

c Open Space Bond Advisory Committee

Ken K To attend

Pat C.

County Lewis + Clark
Facility & # Helena 90
Closure
Finan Assur
GW Corr Meas
GW Monitoring
GW Reports
Inspections
Other:
Landfarm
Liner
Methane
O & M
Run - On
2-5

2-5

City of Helena Landfill #90

Ground Water Corr. Measures

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COMMUNITY SERVICES BUREAU

MEMORANDUM

TO: Centennial Park Stakeholders Group

FROM: Randy Lilje, Director of Parks and Recreation

RE: **Upcoming Meeting with Consultant**

DATE: April 4, 1997

Carl Thuesen, the consultant who is working on the Centennial Park development plan, will be in Helena to meet with stakeholders on Thursday, April 10. The meeting starts at 7 P.M. at Carroll College in room 106 of O'Connell Hall. O'Connell Hall is the building that faces Benton Avenue with St. Charles up high in the background. Park on Benton and go in the front door of O'Connell.

Carl will be wanting to hear from interested groups about programming, design standards, what is needed/wanted--a general laundry list of what people would like to see developed in the area.

Please have your concerns prepared so there will be ample time for everyone. If you need further information, please call my office at 447-8463.

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Solid and Hazardous Waste Bureau
Solid Waste Program
MARC RACICOT, GOVERNOR (406) 444-1430
FAX # (406) 444-1499
STATE OF MONTANA
OFFICE LOCATION 836 Front Street Helena, Montana
MAILING ADDRESS: PO BOX 200901 Helena, MT 59620-0901

November 4, 1993

Richard A. Nisbet
Director of Public Works
City-County Building
316 North Park Avenue
Helena, Montana 59623

SUBJECT: Landscaping Activities at the City of Helena Class II Landfill

Dear Mr. Nisbet:

On November 1, 1993, James Wilbur, Patrick Crowley, and I visited the new transfer station on its first day of operation. We were disturbed to see trees planted around the facility, especially those trees planted on top of the old landfill. There was also a trench being dug for an apparent irrigation system next to the diversion ditch that lies north-south across the old landfill. We also witnessed the workers unearthing solid waste as they dug the trench. By planting trees and installing an irrigation system, the City of Helena is in violation of the rules and regulations governing solid waste disposal in Montana, as well as the closure plan approved by the Montana Department of Health and Environmental Sciences. **Any change to an approved closure plan has to be approved of by the Department prior to alteration.** It is very important that the integrity of the final cover of the old City of Helena Class II Landfill is not compromised. And, based on the location of numerous trees and the irrigation trench, this may have already occurred.

The planting of trees and the installation of an irrigation system was discussed in a letter addressed to you back on October 25, 1991 (copy enclosed), as well as in the City of Helena Transfer Station Environmental Assessment (copy enclosed). The Department approved of the planting of only shallow-rooted species on the old landfill only as long as the City installed at least three (3) feet of top soil in conjunction with the minimum two (2) feet of required cover. The Department also requested information on the possible root depths for each species to be planted so that the potential for compromising the integrity of the final cover would be minimal. This information had to be submitted to this office for approval. To my knowledge, the Department never received the forementioned information, nor did we approve of the planting of trees on the old landfill.

Trees have the potential to harm the integrity of the cover material by acting as a pathway for moisture infiltration. The plants may also absorb moisture (leachate) and methane gas generated inside the old cells, which could cause a high mortality rate among the trees.

The installation of an irrigation system on top of the old landfill has not been approved of by this office. An irrigation system was discussed in the Environmental Assessment. However, before the system could be installed, a soil moisture plan had to be submitted and approved by the Department. To my knowledge, such a plan was never submitted or approved. In the event that a ground water corrective action plan is required for the City of Helena Class II Landfill, the Department may require the plan to include changes to the existing irrigation system on closed areas of the landfill.

Therefore, in order for the City of Helena to come into compliance, a plan must be submitted to this office within **30 days** of receiving this letter. This plan should discuss the number and types of trees planted, their rooting depths, and the depth of final cover at each tree location situated on top of buried waste. Concurrently, the plan should include: (1) information on where the irrigation system is being installed; (2) how deep the irrigation system will be installed; and (3) a soil moisture plan similar to the one already approved for the Centennial Park area. Another option is for the City to consider removing trees planted directly on top of the final cover (two feet above waste) and the irrigation system from the old landfill area. The City should evaluate tree locations based on the potential problems indicated in this letter.

If you have any questions or comments, please do not hesitate to contact me.

Sincerely,

Lara M. Dando

Lara M. Dando
Solid and Hazardous Waste Specialist

cc: Ted Hill, City of Helena, 316 North Park Avenue, Helena, MT 59623
Steven Downs, Hydrometrics, Inc., 2727 Airport Road, Helena, MT 59601
Lewis and Clark County Sanitarians' Office, City-County Building, P.O. Box 1723, Helena, MT 59624
Bill Verwolf, Helena City Manager, 316 North Park, Helena, MT 59624

Enclosures: Copy of 10/25/91 Letter, Transfer Station EA
F:\USR\CB5405\WP\CLOSURE\HELENA.CO\TREES.N02

RECEIVED

NOV 2 2 1993

CITY OF HELENA
PUBLIC WORKS

MEMORANDUM

TO: Dick Nisbet, Director of Public Works

FROM: Randy Lilje, Community Facilities Director

RE: Recommended Plan for Plantings and Soil Moisture Control at the City's Landfill and Transfer Station

DATE: November 18, 1993

I have reviewed the November 4, 1993, letter from the Montana Department of Health and Environmental Sciences, Solid and Hazardous Waste Bureau regarding landscaping activities at the city's class II landfill. The following are my recommendations for the subject plan and the reasons for them.

The number and types of trees, shrubs, and grasses planted should be as noted on the landscape plan for the construction of the transfer station. The bureau has requested that rooting depths be attached to the different species of plants. However, I am not aware of any material that gives this information nor have I been able to locate it. Of course, any information giving depths of roots would serve only as an average under controlled conditions, probably optimum for root development.

What I have been able to find regarding the development of trees and shrubs in general is this: "The large majority of the roots are very shallow. The active and supportive root system is in the upper 10 to 12 inches of soil."[1] Also, it is very unlikely that the roots would even grow into the clay cap layer.

In bulletins No. 3 and 5 put out by the National Arbor Day Foundation, it states, "...roots need oxygen to grow, they don't normally grow in compacted, oxygen poor soil...." The (root) zone occupies a surprisingly large and shallow area, with most roots in the top 12 inches of soil,...their lower limit depends on where they reach barriers such as bedrock, a hard pan, or a lack of oxygen caused by a high water table or insufficient air passage through soil."[2]

It would seem to me that the clay cap installed over the landfill would serve as the barrier as described above. Krohe seems to agree with this premise in his article "Engineering Nature." In it Krohe describes what officials of both the state and city of New York found at the Fresh Kills landfill on Staten Island, one of the largest in the nation. Krohe describes "In the presence of skeptical state environmental regulators, they (New York landfill

personnel) dug up healthy six-year old volunteer locusts and black cherries and found **no roots had penetrated the cap** (emphasis mine), even though some grew in only four inches of topsoil. Instead, the trees sent their roots laterally."[3]

William Young, landscape architect for New York City's Department of Sanitation further reports, "Test plantings of trees at Fresh Kills landfill cause no damage to the clay cap. In fact, the roots of trees grow away from the cap. Trees don't want to go into a clay cap because it's the worst place for roots to go."[4]

The species of plants chosen for our landfill site were selected because they are native to the region and able to thrive under the extreme climatic and soil conditions of the Helena valley. These plants have all been known to grow in poor topsoil that is six inches or less in depth. With the clay cap, these roots should go nowhere near the garbage. However, if required, a layer of topsoil could be placed over the clay. I would recommend this layer be 6 to 12 inches maximum. Based on the above information, the three feet recommended by the Department is excessive and unwarranted.

The Department further requests information on where the irrigation system is being installed and how deep the system is installed. This information is all included within the landscape plans and specs for the construction of the transfer station. All irrigation lines are being installed relatively shallow, to my recollection, with the deepest being a maximum of 12 inches. And as you well know, a contractor is not going to dig deeper than he/she has to!

In my opinion, the soil moisture monitoring plan does not have to be anywhere near as complicated as the Department has required for Centennial Park. At Centennial Park with its nightly watering of turfgrass, I can understand some concern about the irrigation water possibly penetrating the cap into the garbage. However with all our watering, constant monitoring using a variety of methods, and a cover that is not as "tight" as the clay used on the last phase, we have yet to discover problems. leachate generation & methane

In addition, the type of irrigation used at the transfer station will be drip. This will cut the water use up to 70 percent over a conventional system.

Therefore, I recommend determining the maximum water consumption required for a 24-hour period. Then the meter should be read daily to see if there are any unusually high increases indicating a possible break in a line. In addition, I would recommend monthly testing for the depth of moisture by use of a soil probe. If no

personnel) dug up healthy six-year old volunteer locusts and black cherries and found no roots had penetrated the clay (sequoias mine), even though some grew in only four inches of topsoil. Instead, the trees sent their roots laterally."

William Young, landscape architect for New York City's Department of Sanitation further reports, "Test plantings of trees at Fresh Kills landfill cause no damage to the clay cap. In fact, the roots of trees grow away from the cap. Trees don't want to go into a clay cap because it's the worst place for roots to go."

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In addition, the type of irrigation used at the transfer station will be drip. This will cut the water use up to 70 percent over a conventional system.

Therefore, I recommend determining the maximum water consumption required for a 14-hour period. Then the meter should be read daily to see if there are any unusually high increases indicating a possible break in a line. In addition, I would recommend monthly testing for the depth of moisture by use of a soil probe. If no

problems are observed the first year, then testing two or three times per year should be sufficient. In my opinion, a neutron probe really does not provide any more useable information than the common soil probe. The neutron probe is both costly and unnecessary.

In conclusion, the landscape plan specified in the transfer station construction documents is based on both our experience in the field and research from other areas. The above plan should adequately address the Department's concerns without adding undue effort and expense.

I am also attaching my memo to you dated 11-19-91 which addresses some of the other concerns the Department had.

attach.

[1]Whitcomb, C. E., 1986, Landscape Plant Production, p. 291, 506
[2]Fazio, J. R., "How Roots Really Work," Tree City USA Bulletins No. 3 & 5
[3,4]Krohe, J., "Engineering Nature," Landscape Architecture magazine, 10-93, p. 74, 75

pa/ck/lndscpng.mem/11-93

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pa\ck\lndscpng.mem\11-93

City of Helena
Class II L.f. #90

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Solid and Hazardous Waste Bureau
Solid Waste Program
MARC RACICOT, GOVERNOR (406) 444-1430
FAX # (406) 444-1499

STATE OF MONTANA

OFFICE LOCATION 836 Front Street Helena, Montana
MAILING ADDRESS: PO BOX 200901 Helena, MT 59620-0901

October 18, 1993

Richard A. Nisbet
Director of Public Works
City of Helena
City-County Building
316 North Park Avenue
Helena, Montana 59623

SUBJECT: City of Helena Class II Landfill Inspection and Closure Plan Approval

Dear Mr. Nisbet:

The purpose of this letter is two fold: First, I would like to discuss the closure plans submitted to this office. Second, I would like to discuss my inspection of the City of Helena Class II Landfill and the City of Helena Transfer Station. The Montana Department of Health and Environmental Sciences has reviewed all information pertaining to the closure of the City of Helena Class II Landfill (license number 90) submitted by the City of Helena and Hydrometrics, Inc. After reviewing these plans, the Department has approved them. Once the two feet of clay has been applied to the more recent disposal areas and the City is ready to test its thickness, please notify me. In order to help verify the required 18 inch (minimum) infiltration layer, I want to be present when the test pits are dug. Also, let me remind you that at least six inches of earthen material capable of sustaining native plant growth is required as of October 9, 1993 (Administrative Rules of Montana 16.14.530(1)(a)(i)). If the City wants to use six inches of clay for this layer it must demonstrate that the clay can sustain plant life, as well as minimize erosion.

When all the closure work has been completed, please notify this office. The Department can then schedule a time when someone from this office can carry out a closure inspection of the site.

The methane monitoring program submitted in the *Revised Helena Landfill Closure Plan*, March 1993, by Hydrometrics, Inc. has also been approved. The only condition is that all sites listed in Table 6.3, page 44, as well as those sites illustrated in Figure 6.1, page 46, are monitored for methane quarterly, as indicated in the text.

The City of Helena Class II Landfill should meet the conditions discussed in the Department's "Closure Guidance Policy". This document defines requirements and recommendations for landfill

closures in Montana, including 40 CFR Part 258 (Subtitle D) requirements. Enclosed is a copy of the "Landfill Closure Review Sequence" which outlines the entire landfill closure approval process.

As you know, on October 13, 1993, I visited the City of Helena Class II Landfill and the City of Helena Transfer Station (license number 320). Thank you for showing me around both facilities. It was exciting to see the transfer station coming close to completion. Over all, the Class II landfill was looking very good. There were some areas, however, of inadequate cover that have to be corrected as soon as possible to prevent litter from spreading off-site. In regard to the transfer station, everything appears to be going according to the plans approved by the Department. The only thing that appears to be lacking was the retention pond, which you told me was to be constructed once some of the construction equipment and trailers are removed. Please notify us when the pond has been completed so that we can make proper notification in our files.

Enclosed you will find a copy of my inspection reports. An explanation of the rule that was violated can be found on a separate page. All violations need to be corrected in order to bring your operation into compliance.

Thank you again for your cooperation and assistance. If you have any questions or comments, please do not hesitate to contact me.

Sincerely,

Lara M. Dando

Lara M. Dando
Solid and Hazardous Waste Specialist

cc: Ted Hill, City of Helena, 316 North Park Avenue, Helena, MT 59623
Steven Downs, Hydrometrics, Inc., 2727 Airport Road, Helena, MT 59601
Lewis and Clark County Sanitarians' Office, City-County Building, P.O. Box 1723, Helena, MT 59624

Enclosures: Landfill Closure Review Sequence, Inspection Reports
F:\USR\CB5405\WP\CLOSURE\HELENA.CO\CLOSAPPR.013

SOLID WASTE MANAGEMENT SYSTEM INSPECTION REPORT

Name of Site: City of Helena Class II Landfill
Date: October 13, 1993
License #: 90
Class: II
County: Lewis & Clark
Location: Between Carroll College & Bill Roberts Golf Course
Operator: City of Helena
Address: 316 N. Park Ave. Helena, MT 59623
Owner: Washington Corporation
Address: P.O. Box 8182 Missoula, MT 59807

	Violation Major	Minor	Comment
Violations explained on Page Two			
1. Burning Controlled: YES			
2. Disposal Site Properly Located: YES			
3. Dumping Confined to a Manageable Area: YES			
4. Refuse Properly Covered After Each Operating Day:		XXX	
5. Spreading and Compaction of Refuse Adequate: YES			
6. Rodents and Insects Controlled: YES			
7. Blowing Litter Controlled: YES			
8. Access to Site Controlled: YES			
9. Approach Road Properly Maintained: YES			
10. Other (see next page):			XXX

Control of Site: Yes Signs Yes Fences and/or Gates Yes Supervision

Equipment Visible On-Site: X Yes ___No

Type: Front-end Loader, Numerous Graders

Person(s) Seen: Richard Nisbet, City of Helena

Signature of Inspectors: Lara M. Dando

Lara M. Dando
Solid Waste Program

MINOR VIOLATION:

#4) **Refuse Properly Covered After Each Operating Day** (Administrative Rules of Montana (ARM) 16.14.521(2)(a)) - All Class II sites using landfilling methods shall compact and cover solid waste with a layer of at least six (6) inches of approved cover material at the end of each operating day.

Upon inspection, I found an area on the south side of the landfill with insufficient cover. All Group II material is required to be covered with at least six inches of cover at the end of each operating day.

COMMENT:

#10) **Used Oil Tank** - The used oil collection tank at the entrance of the landfill was not locked at the time of my inspection. The tank lid was open, enabling anyone to dump anything into it. There were also several containers (including one antifreeze container) sitting by the tank. In order to prevent the used oil from being contaminated and thus creating a Subtitle C regulated hazardous waste, access to the tank must be controlled better.

SOLID WASTE MANAGEMENT SYSTEM INSPECTION REPORT

Name of Site: City of Helena Transfer Station Date: October 13, 1993

License #: 320 Class: II

County: Lewis & Clark Location: Between Carroll College & Bill Roberts Golf Course

Operator: City of Helena Address: 316 N. Park Ave. Helena, MT 59623

Owner: Washington Corporation Address: P.O. Box 8182 Missoula, MT 59807

	Violation Major	Minor	Comment

Violations explained on Page Two

1. Burning Controlled: YES
2. Disposal Site Properly Located: YES
3. Dumping Confined to a Manageable Area: YES
4. Refuse Properly Covered After Each Operating Day: YES
5. Spreading and Compaction of Refuse Adequate: YES
6. Rodents and Insects Controlled: YES
7. Blowing Litter Controlled: YES
8. Access to Site Controlled: YES
9. Approach Road Properly Maintained: YES
10. Other (see next page): NONE

Control of Site: _Yes_ Signs _Yes_ Fences and/or Gates _Yes_ Supervision

Equipment Visible On-Site: _X_ Yes ___ No

Type: Construction Equipment

Person(s) Seen: Richard Nisbet, City of Helena

Signature of Inspectors: Lara M. Dando

Lara M. Dando
Solid Waste Program

cb5405\wp\inspect.93\lew&clrk.co\tstation.013

LANDFILL CLOSURE REVIEW SEQUENCE

A Pre-closure discussions with licensee

B Landfill Closure Plan received

C Landfill Closure Plan review by DHES

D Approval (or Disapproval) of Landfill Closure Plan Letter sent by DHES

E DHES notified Landfill is in "interim closure"

F DHES conducts Landfill Closure Inspection

G Deficiency letter (DL) letter sent to licensee

H Licensee responds to Deficiency letter (DL)

I DHES conducts Landfill Closure Inspection

J Landfill Closure Approval Letter sent by DHES to licensee

K Licensee surrenders Solid Waste Management license to DHES

L Landfill in final closure

M Landfill put in "Final Closure" Files

Files: Lewis + Clark Co
City of Helena

Commissioners
Kay McKenna, Mayor
Margaret Crennen
Tom Huddleston
Colleen McCarthy
Mike Murray

City-County
Administration Building
316 North Park
Helena, MT 59623

Phone: 406/447-8000

William J. Verwolf
City Manager

City of Helena

June 30, 1993

RECEIVED
JUL 0 6 1993
MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES

Ms. Lara M. Dando
Environmental Specialist
Dept. of Health & Env. Sciences
Solid and Hazardous Waste Bureau
Solid Waste Program
836 Front Street
Helena, MT 59620-0901

Re: City of Helena Landfill Closure

Dear Ms. Dando:

In your May 18, 1993 letter, you request additional information concerning the March 1993 closure plan. I will respond to each of the items listed in your letter.

1. I am attaching a copy of the abandonment description for well number 82-4 that was completed by Hydrometrics on May 5, 1992 when the well was abandoned.

2. The City does not have a map showing the waste cells in the Centennial Park area. As the City expands the potentiometric maps, this area will be included.

3. I gave this to you and Jim at our June 1 meeting.

4. I gave this to you and Jim at our June 1 meeting.

As for the storm drain channel design in your three questions, I respond as follows:

1. The attached map shows a portion of the Certificate of Survey where the ditch runs through and shows the storm drain easement. In the future, when we prepare the new maps for our ongoing monitoring program, we will add the ditch.

2. The canal was a requirement of your predecessor when we first started our closure plan. We anticipated that moving the discharge point of the storm drain further away from the landfill would reduce the potential for discharge water to mound back into the landfill wastes

and produce leachate. City staff and solid waste officials felt that getting continual runoff would be in the City's best interests, and that is why we have been pursuing the channel lining.

3. I am not sure how we can monitor potential impacts other than our ongoing groundwater monitoring levels. Hydrometrics suggested that we may want to do some monitoring in the infiltration gallery well that the golf course uses to see if there has been any impact. However, since we have not been monitoring this in the past, I am not sure that this will be beneficial. The City would be receptive to any ideas that you might have for ongoing groundwater monitoring levels.

Regarding the pits that were dug on the landfill site, we have excavated numerous others on the main portion of the landfill. All of the tests exceeded the 24 inches of clay including the six additional inches for the final cover material. We are short on the north slope, and we are in the process of adding more clay. This will be completed once Rail Link buries the communication lines that are parallel to the railroad tracks. Once that is completed, we will do the additional testing necessary to assure that we have the required minimum cover.

I hope this information meets your requirements. I want to thank you for assisting the City in reviewing our final closure plan. If you have any questions or need any additional information, please don't hesitate to call me.

Sincerely,

Richard A. Nisbet, P.E.
Director of Public Works

RAN/skw

c Steve Downs
Ted Hill

lfclosur.ltr

Hydrometrics, Inc.
2727 Airport Road • Helena, Montana 59601 • (406) 443-4150 • FAX (406) 443-4155

WELL ABANDONEMENT DESCRIPTION

Project: Helena Landfill
Date: 5-7-92
Personnel: BP,CO

Well: 82-4

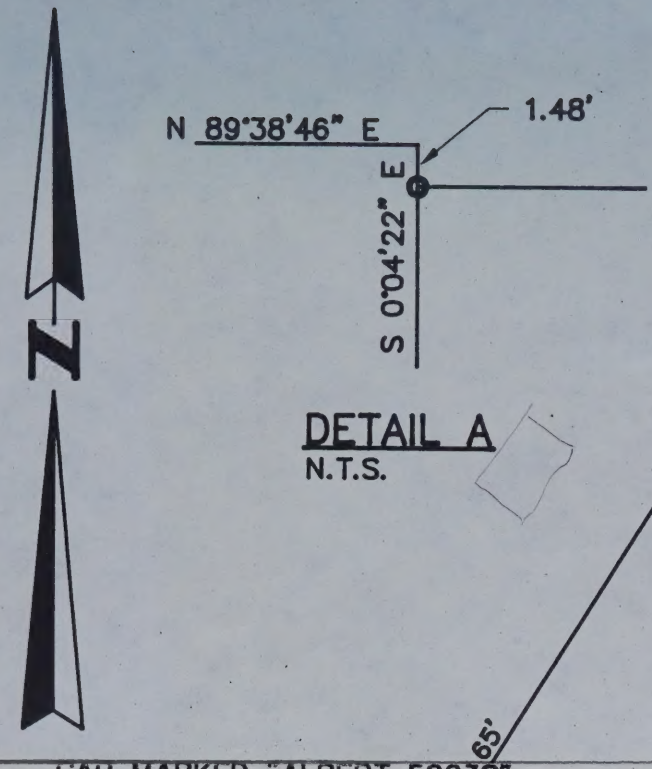
Abandonment Description:

Total depth and static water level were measured. TD was approximately 79 feet and SWL was about 60 feet. Bentonite pellets were slowly poured into well and annular space to provide a bentonite seal. Pellets were added very slowly and the progress up the well bore was measured frequently to ensure no bridging occured. Pellets were added until the well bore and annulus was sealed to one foot above the water table. Three 50 pound buckets of pellets were used. Then one bag of bentonite crumbles and thirteen bags of bentonite chips were slowly added and hydrated with City tap water to seal the rest of the well to three feet below ground level. Frequent measurements were made to ensure that bridging did not occur. The top three feet of the steel casing was removed by the City and backfilled as per DNRC regulations.
All procedures and materials used were as required by DNRC regulations.

STORM DRAIN DITCH EASEMENT

An easement to construct, operate and maintain a ditch to co
described tract of land: A strip of land 40 feet wide being 3
centerline with the sides shortened or extended to end on the
certificate of survey.

Centerline Description: Beginning at a point on the northe
Railroad which bears N 66°50'00" W 11.30 ft. from the south
ft.; thence, N 17°00'00" E 75.00 ft.; thence, N 8°00'00" W 17
R-1 which bears N 32°11'00" E 267.94 ft. from the southwest cor



CERTIFICATE OF COUNTY TREASURER

I, Kim Harris Treasurer of Lewis & Clark County, Montana do hereby certify that the accompanying plat has been duly examined and that no real property taxes assessed and levied on the land to be subdivided are delinquent. (Geo 1888-1944-11-5-0000)

Dated this 17th day of January, 1992.

K K Jorgen

CERTIFICAT

I, _____

Montana, do hereby certify t
office this ____ day of ____
of the Rcords of the County

_____

STORM DRAIN DITCH EASEMENT

An easement to construct, operate and maintain a ditch to co
described tract of land: A strip of land 40 feet wide being 2
centerline with the sides shortened or extended to end on the
certificate of survey.

Centerline Description: Beginning at a point on the northe
Railroad which bears N 66°50'00" W 11.30 ft. from the south
ft.; thence, N 17°00'00" E 75.00 ft.; thence, N 8°00'00" W 17
R-1 which bears N 32°11'00" E 267.94 ft. from the southwest cor

N

GRAPHIC SCALE

0 40 80 160

1"=80'

N 89°38'46" E 1.48'

S 0°04'22" E

DETAIL A
N.T.S.

N 89°55'45" E 441.19'

ACCESS EASEMENT
APPURTENANT TO
TRACT A.

25'

GRUBER
R1 ~ 4.387 AC.
(REMAINDER OF BK. 273, PG. 560)

629.65'

R=100'

N 9°50'43" E
34.33'

S 75°14'00" W
286.71'

STORM DRAIN DITCH
EASEMENT

20'

N 32°11'00" E

N 75°19'26" E
383.37'

20'

GRUBER
R2 ~ 0.734 AC.
(REMAINDER OF BK. 278, PG. 54

78.07'

S 89°58'20" W 290.99'

422.17'

S 00°20'15" E

GRUBER
M5-3702

TRACT A
2.500 AC.

N 23°40'23" E
175.62'

70.00'

401.57'

N 66°50'00" W

S 09°50'43" W
309.77'

201.83'

N 89°38'46" E
226.49'

GRUBER
R3 ~ 1.112 AC.
(REMAINDER OF BK. 278, PG. 542)

S 0°04'22" E
224

775.98'

304.40'

B.N. RAILROAD RIGHT

LEGEND

- ● FOUND 3/4" REBAR
- O FOUND 1" O.D. IRON PIPE
- △ FOUND 5/8" REBAR WITH 1 1/4" PLASTIC CAP MARKED "WHT 3366 ES"
- ▫ FOUND STEEL FENCE POST
- ⊠ FOUND "X" CHISELED ON CONCRETE FOUNDATION
- ⊙ SET 5/8" x 30" REBAR WITH ORANGE PLASTIC CAP MARKED "ALBERT 5203S"

MONTANA
DAVID M. ALBERT
5203 S
REGISTERED
LAND SURVEYOR

David M. Albert

CERTIFICATE OF COUNTY TREASURER

I, Kim Harris Treasurer of Lewis & Clark County, Montana do hereby certify that the accompanying plat has been duly examined and that no real property taxes assessed and levied on the land to be subdivided are delinquent. (Geo 1888-1944-11-5-0000)

Dated this 17th day of January, 1992.

K K Jensen

CERTIFICA

I, _____
Montana, do hereby certify t
office this ____ day of ____
of the Rcords of the County

_____



L & C County

Class II Closure #90

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: Proof ✱ DATE: 6/24/93

1. ~~Jon~~ JW
2. ~~Roger~~ RCS
3. ~~Duane~~ DH

☒ ~~Approval~~	☒ ~~Comment~~	☐ Necessary Action
☐ Note and Return	☐ Note and File	☐ Investigate
☐ Prepare reply	☐ Signature	☐ See Me
☐ As requested	☐ For your information	☐ Per Conversation

REMARKS: Please file ~~in~~ a copy in the City of Helena Class II Closure file and one in the Complaint file (give to Carol)

cc: Steve Pilcher ✓ 6-25-93

Thanks!

FROM: Lara D.

Sent 6-25-93 lm

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Solid and Hazardous Waste Bureau
Solid Waste Program
MARC RACICOT, GOVERNOR **(406) 444-1430**
FAX # (406) 444-1499
STATE OF MONTANA
OFFICE LOCATION 836 Front Street Helena, Montana
MAILING ADDRESS: PO BOX 200901 Helena, MT 59620-0901

TO: Stephanie Wallace, EPA-Helena Office

FROM: Lara M. Dando LMD

DATE: June 28, 1993

SUBJECT: Complaint Received From Concerned Citizens About City of Helena Class II Landfill, License #90

I am writing this memorandum in response to the complaint received via letter concerning the City of Helena Class II Landfill. There appeared to have been three major issues that needed to be addressed in the concerned citizens' letter: methane generation; ground water contamination; and the construction of the transfer station on old waste. Let me address each issue separately, based on information submitted by the City of Helena in their landfill closure plan:

Methane Generation - According to the closure plan, the City of Helena Class II Landfill began methane monitoring on a quarterly basis in 1992. The locations of the wells sampled and the results of the sampling events are on-file in this office. The Montana Power Company Office, YMCA Basement, Armory, Elk River Concrete, and the landfill office were also sampled each time. Once the transfer station has been built, it too will be monitored for methane generation. Methane monitoring in the area of the landfill has shown that lateral migration of methane from the landfill to adjacent properties is generally minimal. The Solid Waste Program is currently working with the city to design a more extensive methane monitoring program.

Ground Water Contamination - Ground water monitoring around the landfill has occurred semiannually since January 1992. The location of the wells, parameters tested, and results of sampling events are on-file in this office. Ground water monitoring at the landfill has shown that water downgradient of the landfill contains several organic constituents that are being watched closely. The program is currently working with the city to design a more extensive ground water monitoring program for the landfill.

Transfer Station Construction - This spring, the City of Helena began construction on their licensed transfer station (#320). The building itself, as you know, will not be built on buried waste, but on ground previously used by Elk River Concrete. Only the roads leading to the station would be placed on buried waste, and this area has been designed to protect the integrity of the final cover. Approved transfer Station plans are on-file in our office.

cb5405\wp\closure\helena.co\complnt.624

ROUTING AND TRANSMITTAL SLIP

Date: 6/17/93

TO: (Name, office symbol, room number, building, Agency/Post)	Initials	Date
1. John Dilliard		
2. STWB		
3.		
4.		
5.		

	Action		File		Note and Return
	Approval		For Clearance		Per Conversation
	As Requested		For Correction		Prepare Reply
	Circulate		For Your Information		See Me
	Comment		Investigate		Signature
	Coordination		Justify		

REMARKS

John - could you please give me a call about this? Thanks.

RECEIVED
JUN 21 1993
MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE BUREAU

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

FROM: (Name, org. symbol, Agency/Post)	Room No.—Bldg.
T. Wallace, EPA	Phone No.

May 7, 1993

To whom it may concern,

The current City of Helena landfill has many buildings on or adjacent to the landfill. A college is located in close proximity and to date no work has been done to consider monitoring or mitigation of explosive landfill gas. We have been told this is a violation of Subtitle D and the RCRA Act as contained in parts 257, 258 and the Clean Air Act (CAA).

Currently the city is building a large transfer station on or practically on the old fill. In addition to the explosive hazards to personnel, there is also liability from asphyxiation, smog, odor, greenhouse, vegetation or groundwater contamination.

With a college, YMCA and workers inside enclosed buildings, it appears as if a serious accident is just waiting to happen.

As I understand it from the regulatory agencies, OSHA and the EPA are the only federal agencies that will consider action. I hope a review will save someone from a serious injury.

My neighbors and I have been told that after October, 1993 we may bring law suits against the owner and operators of the City landfill property under RCRA guidelines (at this time we have not been able to determine the owner). It is until October that we are worried about. Please see if there are safety precautions being considered in the old and new buildings planned (designs, migration and collection devices as well as education of students, etc.).

Very truly yours,

Concerned Citizens

cc: OSHA
EPA
Carroll College
MEIC
YMCA

ENVIRONMENTAL PROTECTION AGENCY
JUN 2 1993
MONTANA OFFICE



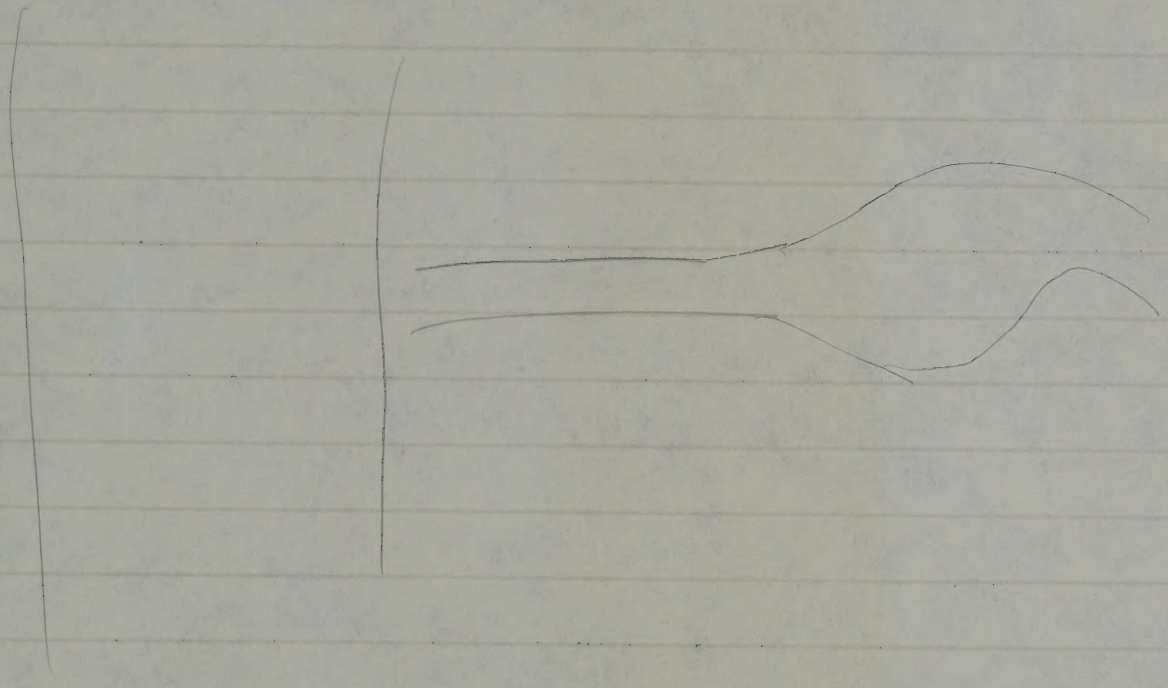


OFFICE OF THE DIRECTOR
ENVIRONMENTAL PROTECTION AGENCY
FEDERAL BUILDING
HELENA MT 59602

6/1/93

City of Helena Closure Meeting 1:00 pm

Attendance: Jim Wilbur, Lara Dando, & Richard Nisbet



DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Solid and Hazardous Waste Bureau
Solid Waste Program
MARC RACICOT, GOVERNOR **(406) 444-1430**
FAX # (406) 444-1499
STATE OF MONTANA
OFFICE LOCATION 836 Front Street Helena, Montana
MAILING ADDRESS: PO BOX 200901 Helena, MT 59620-0901

May 18, 1993

Richard A. Nisbet
Director of Public Works
City of Helena
City/County Building
316 North Park Avenue
Helena, Montana 59623

SUBJECT: City of Helena Closure

Dear Mr. Nisbet:

On April 30, 1993, James Wilbur, Pat Potts, and I met with Ted Hill, City of Helena, and Mike Wignot and Steven Downs, Hydrometrics, Inc., to discuss certain closure aspects for the City of Helena Class II Landfill. Mr. Downs has already informed you as to what was discussed at that meeting in his May 4, 1993 letter to you. The purpose of this letter is to formally request the following information concerning the landfill's March 1993 revised closure plan:

(1) Information on the procedures taken for well abandonment for well number 82-4, situated in the center of the landfill.
(2) A plan map indicating the location of all waste cells, including the area of Centennial Park (if the information is available), in relation to potentiometric contours.
(3) A copy of the plans for the transfer station's detention pond, for our files.
(4) A plan map indicating the run-off/run-on diversion ditch situated between the transfer station site and the rest of the closed landfill (it appears to run north-south across the landfill).

A separate plan sheet for each of the items requested above is not required. If you can fit some of the information on the same sheet, that would be acceptable. It is not our intention to hold up the construction of the transfer station or the landfill closure process, but to make sure there is documentation on all aspects of closure in our files.

Concurrently, the Montana Department of Health and Environmental Sciences would like to notify you that the plans for the storm drain channel design have been approved. We would

overflow from Eureka Well + storm water

like the following additional information for our records: (1) a plan map showing the extent of the channel into the neighboring property; (2) a brief discussion on how the new channel design will help prevent potential ground water contamination; and (3) a plan for monitoring potential impacts.

On May 12, 1993, Bill Michalson, City of Helena, and I (with the help of a back-hoe) dug fourteen (14) test pits to verify that at least eighteen (18) inches of compacted clay had been placed over waste in the area of the future transfer station. All but one, at seventeen (17) inches, had more than the minimum required for closure. Mr. Michalson has reassured me that this will be corrected. Therefore, MDHES is satisfied that the waste has been properly covered with the compacted clay and does not foresee any delays in the continued construction of the transfer station or the closure of the landfill. I would like to thank Mr. Michalson for inviting me out to the landfill on such a beautiful day to help with the test pits. Keep up the good work!

If you would prefer to meet and discuss these questions or any other aspect of the closure plan, James Wilbur, Pat Potts, and I would be willing to meet with you. Just give us a week lead time to get everything set up. In the meantime, please do not hesitate to contact this office if you have any questions or comments.

Sincerely,

Lara M. Dando
Environmental Specialist

cc: Ted Hill, City of Helena, 316 North Park Avenue, Helena, MT 59623
Steven Downs, Hydrometrics, Inc., 2727 Airport Road, Helena, MT 59601
f:\usr\cb5405\wp\closure\helena.co\drain.513

Lewis & Clark

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: DATE: June 2, 1993

1. June TW
2. Jon JD
3. File: Lewis & Clark Co/City of Helena Class II Landfill Closure file

☐ Approval	☐ Comment	☐ Necessary Action
☐ Note and Return	☐ Note and File	☐ Investigate
☐ Prepare reply	☐ Signature	☐ See Me
☐ As requested	☒ For your information	☐ Per Conversation

REMARKS:

Maps & slides attached

FROM: Lara D.

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Solid and Hazardous Waste Bureau
Solid Waste Program
MARC RACICOT, GOVERNOR (406) 444-1430
FAX # (406) 444-1499
STATE OF MONTANA
OFFICE LOCATION 836 Front Street Helena, Montana
MAILING ADDRESS: PO BOX 200901 Helena, MT 59620-0901

TO: City of Helena Class II File, License Number 90

FROM: Lara M. Dando LMD

DATE: June 2, 1993

SUBJECT: May 12, 1993 Test of 18" Clay Cover Over Waste, Transfer Station Area

On May 12, 1993, at 1:30 p.m., I met with Bill Michalson, City of Helena, and Chuck, back-hoe operator, at the City of Helena Class II Landfill in order to test the adequacy of 18" of compacted clay for an infiltration layer in the vicinity of the future transfer station. We dug a total of 14 pits throughout the area where the transfer station will be built (see attached map). The following is a compilation of my notes on each pit:

TEST PIT 1 -
Location: Dug near future entrance to entire site in future roadway.
Depth: 18" to waste.

TEST PIT 2 -
Location: Dug in future north-south roadway; east side of site;
Depth: 22" to waste (City will cut 4" off to make 18" and to help grade the road).

TEST PIT 3 -
Location: Further west along future roadway to southern entrance to building.
Depth: 21" to about 2' of gravel that was placed on top of daily cover to get it to grade.

TEST PIT 4 -
Location: Further west along future roadway to southern entrance to building.
Depth: 20" to about 2' of gravel that was placed on top of daily cover to get it to grade.

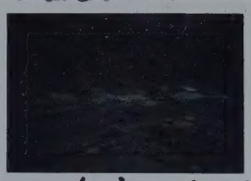
TEST PIT 5 -
Location: Located by southern entrance to transfer station.
Depth: 18-19" to 2' of gravel that was placed on top of daily cover to get it to grade.

4/30/93 Helena, MT
City of Helena Class II
-closure work-



Storm Drain
Extension

4/30/93 City of Helena
class II Landfill
-closure work-



storm drain extension

4/30/93 City of Helena
Class II Landfill
-closure work-



storm drain extension
area

4/30/93 City of Helena
Class II Landfill
-closure work-



Infiltration gallery
north of landfill

4/30/93 City of Helena
Class II Landfill
-closure work-



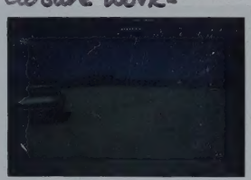
Storm drain extension
Looking south

5/12/93 City of Helena
Class II Landfill
-closure work-



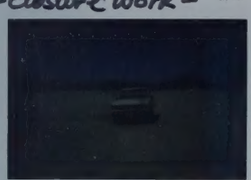
Testing 18" of compacted
clay in transfer
station area.

5/12/93 City of Helena
Class II Landfill
-closure work-



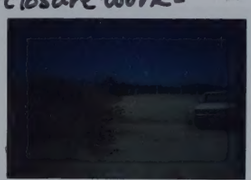
Future site of transfer
station.

5/12/93 City of Helena
Class II Landfill
-closure work-



Future site of transfer
station

5/12/93 City of Helena
Class II Landfill
-closure work-



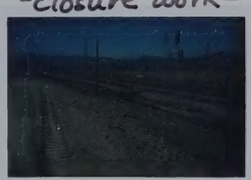
Area of future transfer
station. Stockpiled
cover material.

5/12/93 City of Helena
Class II Landfill
-closure work-



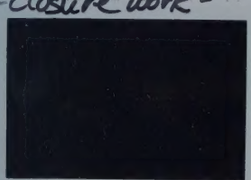
Testing 18" of compacted
clay cover in transfer
station area.

5/12/93 City of Helena
Class II Landfill
-closure work-



Northside of landfill

5/12/93 City of Helena
Class II Landfill
-closure work-



Test pit - checking
18" of compacted clay
cover

5/12/93 City of Helena
Class II Landfill
-closure work-



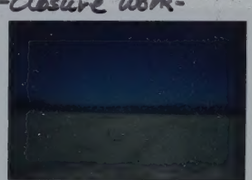
Future site of transfer
station -

5/12/93 City of Helena
Class II Landfill
-closure work-



18" of clay cover on old
waste. Future site of
transfer station

5/12/93 City of Helena
Class II Landfill
-closure work-



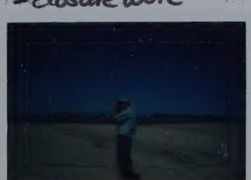
checking 18" of clay cover
on waste.

5/12/93 City of Helena
Class II Landfill
-closure work-



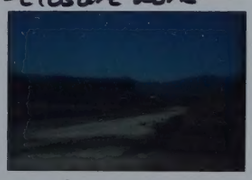
Testing 18" of compacted
clay cover in transfer
station area.

5/12/93 City of Helena
Class II Landfill
-closure work-



Testing 18" of compacted
clay cover in transfer
station area.

5/12/93 City of Helena
Class II Landfill
-closure work-



Working on water system
SW of landfill.

City of Helena
Class II Landfill
License #90

5/12/93

LMD

LMD

Looking north

LMD

LMD

Test pit #1

LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

Bill Nichalson, City of Helena in shot.

LMD

LMD

City of Helena
Class II Variance #90

LMD

LMD

Looking north
LMD

LMD

Test pit #1
LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

LMD

Bill Nichalson, City of Helena in shot.
LMD

LMD

550'
3945
3950
3950
50'
150'
50'
VPI 24+75
VPC 23+75
VPT 22+45
-2.970%
49.9
51.2
51.9
55.0
56.3
Pit 10
12" X 50' C.M.P.
-2.970%
Pit 11
Pit 9
VPI 21+45
57.9
VIRGIN GROUND
LANDFILLED AREA
EXISTING WASTE BOUNDARY LINE
FUTURE 40 C.Y CONTAINER SITE
-2.000%
59.3
3950
Pit 6
Pit 7
+4.676%
Pit 13
VPC 20+45
71.7
69.0
66.8
64.5
62.2
60.7
60.6
18" X 13'-4" CAST IRON GRATE
Top of Grate Elev. = 65.99
Outlet Invert Elev. = 62.99
5.45%
1.00%
GRADE BREAK
WEN LOCATION OF EXISTING EQUIP. GARAGE
12" X 50' C.M.P.
Pit 8
3955
64.5'R
62.19
-2.000%
MANHOLE #11
Pit 5
Pit 4
Pit 3
+4.157%
Pit 2
VPI 18+95
3953.5
Pit 12
8" PVC DRAIN LINE (TYP.)
48" CONC. MANHOLE (TYP.), MANHOLE #10
3955
Stockpiled dirt for top of clay
+2.000%
Pit 1
3960
MONTANA RAIL LINK MAINLINE
REMOVE EXISTING SCALE HOUSE
RELOCATE EXISTING WASTE OIL TANK IN THE RECYCLING AREA
35'-0"
EXISTING EQUIPMENT GARAGE
EXISTING SCALE HOUSE
RELOCATE EXIST. EQUIP. GARAGE ON EAST SIDE OF TRANSFER STATION
SAN 8"

ROUTE SL[redacted]

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: Proofit

DATE: 5/14/93

1. P[3] ✓
2. Jim IW
3. Jon JP
4. Roger pc5
5. Duane DP

☐ Approval	☑ Comment	☐ Necessary Action
☐ Note and Return	☐ Note and File	☐ Investigate
☐ Prepare reply	☐ Signature	☐ See Me
☐ As requested	☐ For your information	☐ Per Conversation

REMARKS:

Please file in ~~Lewis + Clark Co.~~ City of Helena Class II Landfill and a copy in the City of Helena Transfer Station file.

Thank you!

FROM: Lara D.

mailed 5-19-93 lm

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Solid and Hazardous Waste Bureau
Solid Waste Program
MARC RACICOT, GOVERNOR (406) 444-1430
FAX # (406) 444-1499

STATE OF MONTANA

OFFICE LOCATION 836 Front Street Helena, Montana
MAILING ADDRESS: PO BOX 200901 Helena, MT 59620-0901

May 18, 1993

Richard A. Nisbet
Director of Public Works
City of Helena
City/County Building
316 North Park Avenue
Helena, Montana 59623

SUBJECT: City of Helena Closure

Dear Mr. Nisbet:

On April 30, 1993, James Wilbur, Pat Potts, and I met with Ted Hill, City of Helena, and Mike Wignot and Steven Downs, Hydrometrics, Inc., to discuss certain closure aspects for the City of Helena Class II Landfill. Mr. Downs has already informed you as to what was discussed at that meeting in his May 4, 1993 letter to you. The purpose of this letter is to formally request the following information concerning the landfill's March 1993 revised closure plan:

(1) Information on the procedures taken for well abandonment for well number 82-4, situated in the center of the landfill.
(2) A plan map indicating the location of all waste cells, including the area of Centennial Park (if the information is available), in relation to potentiometric contours.
(3) A copy of the plans for the transfer station's detention pond, for our files.
(4) A plan map indicating the run-off/run-on diversion ditch situated between the transfer station site and the rest of the closed landfill (it appears to run north-south across the landfill).

A separate plan sheet for each of the items requested above is not required. If you can fit some of the information on the same sheet, that would be acceptable. It is not our intention to hold up the construction of the transfer station or the landfill closure process, but to make sure there is documentation on all aspects of closure in our files.

Concurrently, the Montana Department of Health and Environmental Sciences would like to notify you that the plans for the storm drain channel design have been approved. We would

like the following additional information for our records: (1) a plan map showing the extent of the channel into the neighboring property; (2) a brief discussion on how the new channel design will help prevent potential ground water contamination; and (3) a plan for monitoring potential impacts.

On May 12, 1993, Bill Michalson, City of Helena, and I (with the help of a back-hoe) dug fourteen (14) test pits to verify that at least eighteen (18) inches of compacted clay had been placed over waste in the area of the future transfer station. All but one, at seventeen (17) inches, had more than the minimum required for closure. Mr. Michalson has reassured me that this will be corrected. Therefore, MDHES is satisfied that the waste has been properly covered with the compacted clay and does not foresee any delays in the continued construction of the transfer station or the closure of the landfill. I would like to thank Mr. Michalson for inviting me out to the landfill on such a beautiful day to help with the test pits. Keep up the good work!

If you would prefer to meet and discuss these questions or any other aspect of the closure plan, James Wilbur, Pat Potts, and I would be willing to meet with you. Just give us a week lead time to get everything set up. In the meantime, please do not hesitate to contact this office if you have any questions or comments.

Sincerely,

Lara M. Dando

Lara M. Dando
Environmental Specialist

cc: Ted Hill, City of Helena, 316 North Park Avenue, Helena, MT 59623
Steven Downs, Hydrometrics, Inc., 2727 Airport Road, Helena, MT 59601
f:\usr\cb5405\wp\closure\helena.co\drain.513

Hydrometrics, Inc.
2727 Airport Road • Helena, Montana 59601 • (406) 443-4150 • FAX (406) 443-4155

May 4, 1992

RECEIVED
MAY 05 1993
MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE

Mr. Richard A. Nisbet
Director of Public Works
City of Helena
City/County Building
316 North Park
Helena, MT 59623

Dear Dick,

The purpose of this letter is to summarize our April 30, 1993 meeting with the Montana Department of Health and Environmental Sciences (MDHES). Attending this meeting were Ted Hill from the City, Mike Wignot and Steve Downs from Hydrometrics, Inc., and Lara Dando, Jim Wilbur, and Pat Potts from MDHES.

The primary objective of the meeting was to discuss the storm drain channel extension, and determine what additional information the MDHES would need in order to obtain a formal approval from them so that the City could finish the construction on the channel. The MDHES replied that they would like a plan map showing the alignment of the channel, a brief description of the potential impacts to groundwater that the channel extension may have, and a suggested plan for monitoring these potential impacts. The MDHES indicated that they had no problems with the channel design itself. Ted Hill indicated that the City engineering department may already have a plan map showing the channel alignment which could be submitted to the MDHES.

The MDHES also discussed several other aspects of the recently submitted "Revised Helena Landfill Closure Plan." The MDHES stated that they were pleased with the Plan's methane monitoring plan, although they would like some of the monitoring sites on Figure 6-1 clarified. The MDHES also mentioned that they would like us to consider adding the City Pool building to the monitoring schedule. They also would like us to provide them with a typical methane monitoring probe diagram.

The MDHES also mentioned that the use of the clayey soils from Site E as the erosion/topsoil layer was acceptable, however the top six inches should not be compacted to help improve its suitability for vegetation. It was also mentioned that if vegetation could not be established on this soil, then the soil may have to be amended, or additional topsoil may be needed.

Pat Potts also mentioned that the MDHES will soon be addressing the Maximum Contaminant Limit exceedances that have been observed in samples from monitoring wells near the landfill. This may require significant additional work by the City to better define groundwater impacts in the area. A meeting to discuss these groundwater issues has been tentatively scheduled for 3:00 P.M., May 6, 1993, so that the City can have an idea of what may be necessary for them to address in their next fiscal year. It was suggested that this meeting include Vivian Drake from the City/County water quality protection district. Potential alternatives for monitoring the storm channel extension affect to groundwater will also be discussed at this meeting.

It is my understanding that Ted Hill is planning to attend the May 6 meeting, and it may be prudent for you to attend also to make sure that the MDHES is aware of the City's perspective on these issues. Please let me know if this time is convenient for you. Please call if you have any questions.

Sincerely,

Steven K. Downs
Senior Engineer

Copy: Lara Dando, MDHES
Ted Hill, City of Helena
Vivian Drake, Lewis and Clark County

u:\sdowns...letters\nisbet11.skd

Lewis + Clark Co. / City of Helena Class II Landfill

ROUTE SL

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: Proof LH P3 ✓ Legend needed on x-sec? DATE: 1/4/93

1. _____ 4. Roger T. RCT
2. Jim W. JW 5. Duane R. DR
3. Jon D. JD

☐ Approval	☑ Comment	☐ Necessary Action
☐ Note and Return	☐ Note and File	☐ Investigate
☐ Prepare reply	☐ Signature	☐ See Me
☐ As requested	☐ For your information	☐ Per Conversation

REMARKS:

Return Attached map to Pat Potts ✓

mailed 1-6-93 lr

FROM: Lara D.

DEPARTMENT OF
HEALTH AND ENVIRONMENTAL SCIENCES
Solid and Hazardous Waste Bureau
Solid Waste Program
(406) 444-1430
STAN STEPHENS, GOVERNOR
FAX #(406) 444-1499
STATE OF MONTANA
OFFICE LOCATION: 836 Front Street Helena, Montana
MAILING ADDRESS: Cogswell Building Helena, MT 59620

January 6, 1993

Steven K. Downs
Hydrometrics, Inc.
2727 Airport Road
Helena, Montana 59601

SUBJECT: City of Helena Class II Landfill Drainage Channel Design

Dear Mr. Downs:

I am writing to you in response to your December 22, 1992 letter to James Wilbur of this office, concerning the City of Helena Class II Landfill drainage channel design. Thank you for submitting this information to us. Upon review several questions arose concerning the drainage design illustrated in Figure 1. First, please explain where exactly this lined drainage channel will be constructed in relation to plan sheet #3, Closure Plan - Final Grading and Drainage, *Helena Landfill Closure Plan*. Similarly, will runoff flow into the existing storm drain inlets located on the north and south sides of the landfill? Third, in order to fully understand the lined drainage channel, please include a legend explaining the various features indicated on Figure 1 (submitted 12/22/92). And finally, where would the buried waste be located in relationship to the lined drainage channel?

If you would prefer to meet and discuss these questions or any other aspect of the closure plan, James Wilbur, Pat Potts, and I would be willing to meet with you. Just give us a week lead time to get everything set up. In the mean time, please do not hesitate to contact this office if you have any questions or comments.

Sincerely,

Lara M. Dando

Lara M. Dando
Environmental Specialist

cc: City of Helena, 316 N. Park Ave., Helena, MT 59623
larad\wp\closure\helnadm.ja1

Hydrometrics, Inc.

2727 Airport Road • Helena, Montana 59601 • (406) 443-4150 • FAX (406) 443-4155

December 22, 1992

Mr. James Wilbur
MT Dept. Health and Env. Sciences
Solid Waste Program
Cogswell Building
Helena, Montana 59620

RECEIVED
DEC 23 1992
MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID AND HAZARDOUS WASTE BUREAU

RE: Helena Landfill Drainage Channel Design

Dear Jim:

City of Helena personnel and I have recently discussed details of the design for the Helena Landfill drainage channel extension with two liner and geotextile distributors. Through these discussions we have developed the final drainage channel design which is described below. Because there are some changes in the design from the one which the MDHES approved in 1991, we thought it prudent to have you review this plan before construction commences.

The final drainage channel design is similar to the conceptual design presented in the Helena Landfill Closure Plan with added geotextile cushion to provide more protection to the liner. This design would consist of a ten foot PVC-lined (20 mil PVC) middle section. The PVC would be sandwiched with a geotextile fabric (unwoven 8 oz. fabric AMOCO 4553 or equivalent) for protection. In addition, the same geotextile fabric would be used to stabilize the side slopes. The entire ditch bottom and side slopes would then be riprapped with approximately 18 inches of riprap with a median size of 8 inches. A thin layer (1-2 inches) of sand or small gravel on top of the fabric within the 10 foot liner section (under the riprap) will provide additional protection to the liner especially during installation. Figure 1 is a cross-sectional detail of the final channel design.

All other design aspects are the same as in the "Helena Landfill Closure Plan" conceptual design which was approved by the MDHES in 1991. These final design criteria will be included in the revised "Helena Landfill Closure Plan" which will be submitted to you in early 1993. The City of Helena would like to complete the construction of this channel as soon as possible, and would like the MDHES to review this final design so that construction may commence.

Thank you for your cooperation on this project. If you have any questions, please call anytime.

Sincerely,

Steve Downs

Steven K. Downs
Geological Engineer

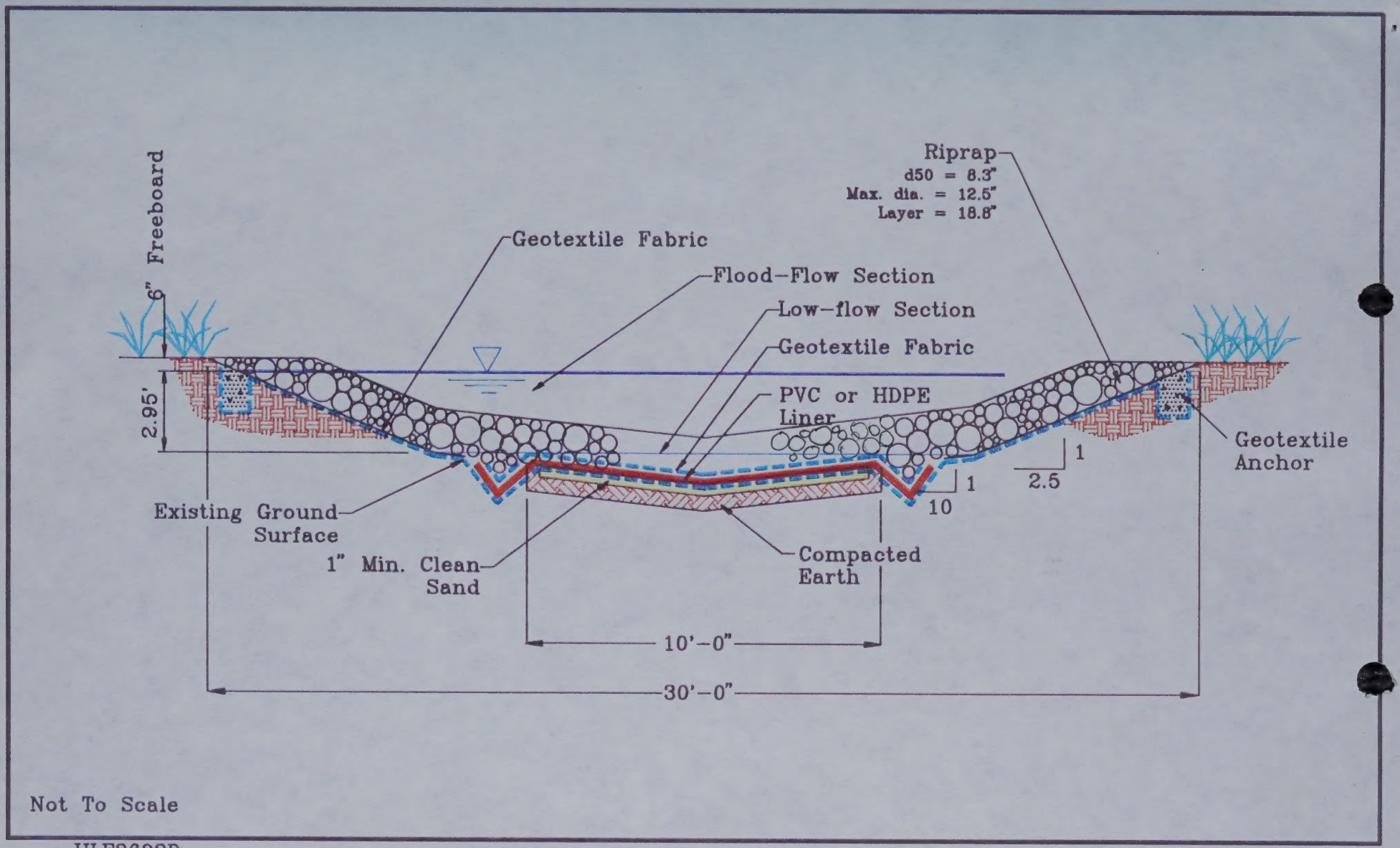
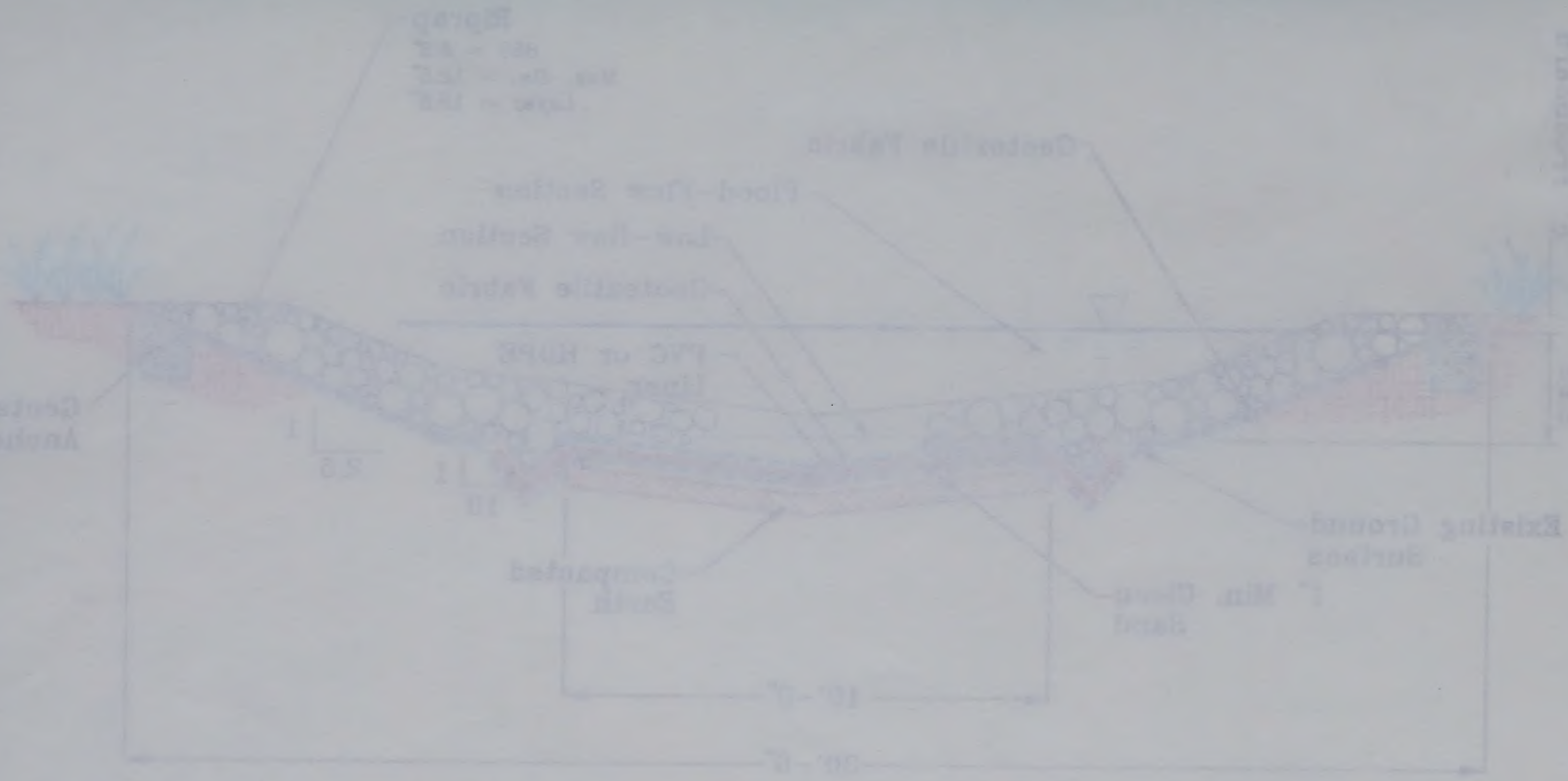


Figure 1.

Storm Sewer Extension Cross-Section
Option 1



Lewis & Clark Class II Closure

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: DATE: 8/3/92

1. Jim JV
2. Jon W & Duane VLR
3. Roger S. City of Helena Landfill File

☐ Approval	☐ Comment	☐ Necessary Action
☐ Note and Return	☐ Note and File	☐ Investigate
☐ Prepare reply	☐ Signature	☐ See Me
☐ As requested	☑ For your information	☐ Per Conversation

REMARKS:

mailed 8-5-92 lh

FROM: Lara D.

TO: City of Helena Class II Landfill Closure File

FROM: Lara Dando LD

DATE: August 3, 1992

SUBJECT: July 29, 1992 Meeting with Hydrometrics and the City of Helena

On July 29, 1992, at 1:30 P.M. Jim Wilbur, Willie Miller (City of Helena), Steve Downs (Hydrometrics), Mike Wignot (Hydrometrics), and myself met here in the Solid and Hazardous Waste Bureau's Lewis Conference Room. The purpose of this meeting was to discuss closure aspects for the City of Helena Class II Landfill. The following is a brief synopsis of the meeting.

1) The City of Helena will reopen the landfill for future use. A plan for this new operation will be submitted. The new lift will be four feet high.

2) Hydrometrics informed us that they are in the process of "revamping" the Closure Plan:

a. Hydrogeology of the Helena Landfill Area - updated;
b. Cover Soil - revised to meet 40 CFR Part 258;
c. Final Cover Design - final contour map will have to be redone;
d. Closure Certification - O.K. as is; and
e. Post-Closure Maintenance and Monitoring - groundwater and methane monitoring will have some changes in it.

3) Hydrometrics now know that they have 90 days to submit a copy of the groundwater monitoring sampling report to our office. Historically, they have waited until the annual report was completed to submit this information to the Solid Waste Program.

4) We discussed soil permeability tests and how much soil required for final cover, especially in relation to future revegetated areas.

5) Willie informed us that the landfill takes asbestos. However, they will phase it out due to the large amount of space required.

6) Post-Closure Care - It was discussed that in order for the Solid Waste Program to approve the final Closure Plan:

a. The City must continue to report monitoring and inspections of the Centennial Park sprinkler system.
b. The revamped closure plan has to include the Centennial Park area as well. There should be a map of this area illustrating where waste had been buried.
c. Probes would be acceptable for sampling for methane. Sampling should focus on the populated sides of the landfill especially. Suggested looking up California's sampling methodology.
d. Quarterly methane monitoring sampling at minimum required.
e. Groundwater monitoring wells could be used for methane monitoring **only** as a back up for the probes.

f. A question was raised over the fate of EPA and DHES wells once used for monitoring by the City of Helena. The City and Hydrometrics felt they were not responsible for these wells.

7) We did not come to any conclusion as to whether or not the field filtration system should be used for groundwater monitoring or not. Something the Program will have to discuss.

larad\wp\closure\helena.731

Closure Plan City of Helena Landfill - July 29, 1992

Name	Representing	Phone #
Jim Wilbur	DHES/SHW	444-1430
Willie Miller	City of Helena	447-8459
Steve Downs	Hydrometrics	443-4150
Mike Wignot	"	"
Lara M. Dando	DHES/SHW	444-1430

ROUTE SLIP

DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

TO: PROOF LL DATE: 11/21/91

1. Jon D. JD
2. Patti P. PP
3. Roger T. RCT Duane R. DH

☑ Approval	☑ Comment	☐ Necessary Action
☐ Note and Return	☐ Note and File	☐ Investigate
☐ Prepare reply	☑ Signature	☐ See Me
☐ As requested	☑ For your information	☐ Per Conversation

REMARKS:

Sent 11/26/91

FROM: Ralph Smith

City of Helena Lic. #90

DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES

STAN STEPHENS, GOVERNOR

FAX #(406) 444-1499

STATE OF MONTANA

OFFICE LOCATION: 836 Front Street, Helena, Montana

MAILING ADDRESS: Cogswell Building, Helena, MT 59620

Solid & Hazardous Waste Bureau
Telephone: (406) 444-1430

November 21, 1991

City of Helena
Dick Nisbet, Director of Public Works
City/County Building
316 North Park Avenue
Helena, MT 59623

Dear Mr. Nisbet:

The purpose of this letter is to acknowledge receipt of the "Helena Landfill Closure Plan" from the City's consultant, Hydrometrics, Inc. The proposed work plan overall is very good, however, there will be additional requirements necessary for proper closure of the City of Helena landfill (License # 90) before the Montana Department of Health and Environmental Sciences (MDHES) will approve the landfill closure plan.

1. It appears that minimum State soil cover permeability requirements will be met in the proposed plan for the City of Helena landfill closure. Federal standards for landfill closure final cover requirements promulgated in EPA Subtitle D Regulations will be required for waste disposal cells which receive wastes after October 9, 1991 and before October 9, 1993. The Federal regulations for final cover requirements are self-implementing. Federal requirements state that the final cover must be designed to minimize infiltration and erosion. The infiltration layer must be a minimum of 18 inches of earthen material that has a permeability less than or equal to the permeability of the natural subsoils, or no greater than 1×10^{-5} cm/sec, whichever is less. The erosion layer must be a minimum of six inches of earthen material that can sustain native plant growth.

2. MDHES strongly recommends that dedicated gas monitoring wells or probes be installed at the City of Helena landfill in order to monitor methane and other gases which have the potential to impact public health and the environment. It is also recommended that a methane venting system be considered. The objective of gas monitoring wells and a methane migration control system is to control the off-site migration of methane and to monitor the methane concentrations in the subsurface at the landfill property line. The main justification for these controls is due to the fact that the landfill is located in an urban area and because there exists a potential for further urban development near the site

itself. This is a public safety issue concern. An additional reason for the implementation of dedicated gas monitoring wells or probes is to ensure that the landfill gases are monitored effectively. **It is unlikely that groundwater monitoring wells are designed to effectively monitor landfill gases at the City of Helena Class II Landfill.**

A well-designed and well-operated landfill gas collection or venting system would, at a minimum: (1) be capable of handling the maximum gas generation rate, (2) have a design capable of monitoring and adjusting the operation of the system, (3) be able to collect gas effectively from all areas of the landfill that warrant control, and (4) be able to expand by the addition of further collection system components to collect gas from areas of the landfill as they require control. The methane monitoring plan presented in Section 6.3 of the landfill closure plan should be revised. The objective of a methane monitoring system is to control the off-site migration of methane and to monitor the methane concentrations in the subsurface at the landfill property line. Federal EPA Subtitle D regulations will require that methane concentrations not exceed the lower explosive limit (LEL) at the property boundary or exceed 25 percent of the LEL in on-site structures. Lower explosive limit (LEL) means the lowest percent by volume of a mixture of explosive gases in air that will propagate a flame at 25° C and atmospheric pressure. The methane monitoring plan should be revised utilizing federal regulations as a **guideline**, because the State Administrative Rules do not have methane monitoring criteria at this time.

The proposed semiannual monitoring frequency for methane appears to be less than the anticipated federal criteria of a quarterly monitoring frequency. However, the frequency of the monitoring events should be determined by on-site conditions and should be conducted quarterly at a minimum. Monitoring should be conducted more frequently during periods when the ground is frozen, as this can restrict vertical migration of the gases and cause increased lateral migration.

3. It has been observed that several groundwater monitoring wells at the City of Helena landfill have had insufficient caps and/or locks on them in the past. The groundwater monitoring well system at the City of Helena landfill could be compromised by a security breach to the system, potentially making groundwater sampling results inconclusive. There should be a complete inspection of all groundwater monitoring wells to ensure proper security measures are taken.

4. The City of Helena landfill groundwater monitoring plan is adequate at this time. Long term groundwater monitoring will be

necessary for the City of Helena landfill to assess the safety of public health and the environment.

5. The City of Helena Centennial Park irrigation system appears to not have been inspected since 1989, according to Appendix 4 of the "Soil Moisture Monitoring Plan Results, Centennial Park Report" received at this office on February 5, 1991. Have inspections been conducted? If inspections were done, please submit copies of documents which verify results of these inspections. It is requested that a updated report on the irrigation system at Centennial Park for the past two years (1990 and 1991) be submitted to this office as soon as possible.

6. Please submit a detailed map which delineates the extent of waste disposal areas in Centennial Park and the areas landfilled adjacent to Carroll College property. Where are the waste disposal limits adjacent to the YMCA ? This is necessary to assess the entire City of Helena landfill closure with respect to all phases of its site life. Please show all these phases of the City of Helena landfill on one map.

7. Centennial Park has small depressions on the final cover in which ponding of precipitation and surface runoff has occurred. Positive drainage must be maintained, so this problem needs to be corrected. Please submit a corrective action plan to resolve this problem.

8. The proposed final cover design for runon/runoff surface drainage control is approved, but the positive drainage concerns with Centennial Park will likely require a modification to the proposed final cover design plan.

9. The plan for extension of the City Storm Drain is approved.

10. It was observed on the City of Helena Transfer Station license application that there were drawings of trees located in areas which had received household wastes. Trees are likely to affect the integrity of the landfill cover, and potential leachate production could increase. Trees or other types of vegetation and/or design features which may compromise the integrity of the landfill cover are not recommended.

11. Post-closure care requirements need to be addressed in the City of Helena landfill closure plan more thoroughly. Following closure of each landfill unit the operator must conduct post-closure care. Post-closure care must be conducted to maintain the integrity and effectiveness of any final cover, including making repairs to the cover (as necessary) to correct the effects of settlement, subsidence, erosion, or other events. The frequency of inspection and corrective maintenance activities for the landfill

final cover should be stated explicitly in the landfill closure plan.

These are the concerns at this time with the City of Helena Landfill (License # 90) Closure Plan. Additional information will be necessary in order to obtain landfill final closure plan approval. Please respond to the concerns and questions I have outlined above. Enclosed is a copy of the "Landfill Closure Review Sequence" which outlines the closure review process. If you have questions or comments, please contact me at your convenience.

Sincerely,

Ralph N. Smith

Ralph N. Smith
Solid Waste Program

Enclosure: "Landfill Closure Review Sequence"

cc: Hydrometrics, Inc., ATTN: Randy Huffsmith, 2727 Airport Road, Helena, MT 59601

Will Selser, City-County Health Dept., City-County Health Dept., 316 N. Park, P.O. Box 1723, Helena, MT 59624

Burlington Northern Railroad, 139 N. Last Chance Gulch, Helena, MT 59601

RNS/rns

LANDFILL CLOSURE REVIEW SEQUENCE

A Pre-closure discussions with licensee

B Landfill Closure Plan received

C Landfill Closure Plan review by DHES

D Approval (or Disapproval) of Landfill Closure Plan Letter sent by DHES

E DHES notified Landfill is in "interim closure"

F DHES conducts Landfill Closure Inspection

G Deficiency letter (DL) letter sent to licensee

H Licensee responds to Deficiency letter (DL)

I DHES conducts Landfill Closure Inspection

J Landfill Closure Approval Letter sent by DHES to licensee

K Licensee surrenders Solid Waste Management license to DHES

L Landfill in final closure

M Landfill put in "Final Closure" Files

City of Helena Landfill Meeting 2/5/91
at Dept. of Health & Environmental Sciences,
Solid & Hazardous Waste Bureau.
Solid Waste Program

NAME	EMPLOYER	PH. #
Ralph N. Smith	DHES-SHWB	444-1430
Tony Grover	" "	" "
Will Selser	L+C County Health	447-8354
Roger Thorvilson	DHES - SHWB	444-1430
Kate McIvor	L&C City/County Health	447-8362
Duane Robertson	DHES-SHWB	444-1430
[illegible]	City of Helena	447-8455
RANDY HUFFSMITH	HYDROMETRICS	443-4150
M.K. BOYD	"	"
Bill Verwolf	City of Helena	447-8000
Richard Nisbet	" " "	447-8426
Jim Wilber	DHES - SHWB	444-1430

City of Helena Landfill Meeting 2/5/91
at Dept. of Health & Environmental Sciences,
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Ralph N. Smith	DHES-SHWB	444-1430
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Kate McIvor	L & C City/County Health	447-8362
Duane Robertson	DHES-SHWB	444-1430
[illegible]	City of Helena	447-[illegible]
RANDY HUFFSMITH	HYDROMETRICS	443-4150
M. K. BOZ	"	"
Bill Verwolf	City of Helena	447-8000
Richard Nisbet	" " "	447-8426
Jim Wilber	DHES - SHWB	444-1430

MEMORANDUM

January 24, 1991

TO: Dick Nesbit, Ted Hill, Ralph Smith, Will Selser, Bill Verwolf

FROM: Randy Huffsmith

RE: Helena Landfill Water Quality Monitoring Program

On November 27, 1990, Hydrometrics, Inc. submitted a report to the City of Helena entitled "Hydrogeologic Investigation of the City of Helena Landfill". This report included a proposed groundwater monitoring plan. On December 18, 1990, Hydrometrics, Inc., in conjunction with City of Helena officials, met with the Montana Department of Health and Environmental Sciences, Solid Waste Bureau (MDHES, SWB) and discussed the proposed plan. Several revisions to the monitoring plan were suggested by the Solid Waste B ureau. These revisions included obtaining samples from a smaller network of wells but analyzing those samples for more parameters. No revisions were suggested to the methane monitoring program.

I have enclosed a finalized monitoring plan which is based on input from the SWB and Will Selser of the County Health Department. We can discuss this plan at our meeting scheduled for February 5 at 1:30 pm at the SWB.

kar

Enclosure

RECEIVED

FEB 05 1991

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID & HAZARDOUS WASTE BUREAU

RECEIVED
FEB 03 1991
MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID & HAZARDOUS WASTE BUREAU

HELENA LANDFILL

WATER QUALITY ANALYTICAL SCHEDULE

Well Number	Analysis	Date
83-6	Phase I Parameters	Spring, Fall
HL90-1	Phase I Parameters	Spring, Fall
HL90-2	Phase I Parameters	Spring, Fall
HL90-3	Phase I Parameters	Spring, Fall
40	Phase I Parameters	Spring, Fall
43	Phase I VOC's	Spring, Fall
47	Phase I VOC's	Spring, Fall
13	Phase I VOC's	Spring, Fall
75	Phase I VOC's	Spring, Fall
EPAI	Phase I VOC's	Spring, Fall

RECEIVED

FEB 05 1991

MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES
SOLID & HAZARDOUS WASTE BUREAU

RECEIVED
FEB 03 1981
MONTANA DEPARTMENT OF HEALTH
AIR & ENVIRONMENTAL SCIENCES
SOLID & HAZARDOUS WASTE BUREAU

MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES
Environmental Sciences Division
Solid Waste Management Bureau
Helena, Montana 59601

Helena I.F. G.W. Corr Measures Notes on point of Compliance Wells.

APPLICATION FOR SOLID WASTE MANAGEMENT SYSTEM LICENSE

Name of applicant: City of Helena

Address: Civic Center Helena Montana

Telephone number: 442-9920

This application is for a: (X) solid waste disposal site, ( ) container site *(green box and bulk containers)*, ( ) transfer station, ( ) resource recovery or processing facility, ( ) other *(please specify)* _____

Community of Helena, County of Lewis & Clark, located in South-4 quarter section of Section 19, Township _____, Range _____. "See Attached Map"

General description of location: South of B.N. mainline, North of Lyndale Ave, East of Carroll College, West of Last Chance Gulch,

Total acreage in site: 38 Usable acreage: 30

Population to be served by solid waste management system: 24,000 +

Will bridges and roads support loaded vehicles? (X) Yes ( ) No

Is site subject to flooding? ( ) Yes (X) No

Are natural drainages found within the site? (X) Yes ( ) No

Depth to groundwater: 30'

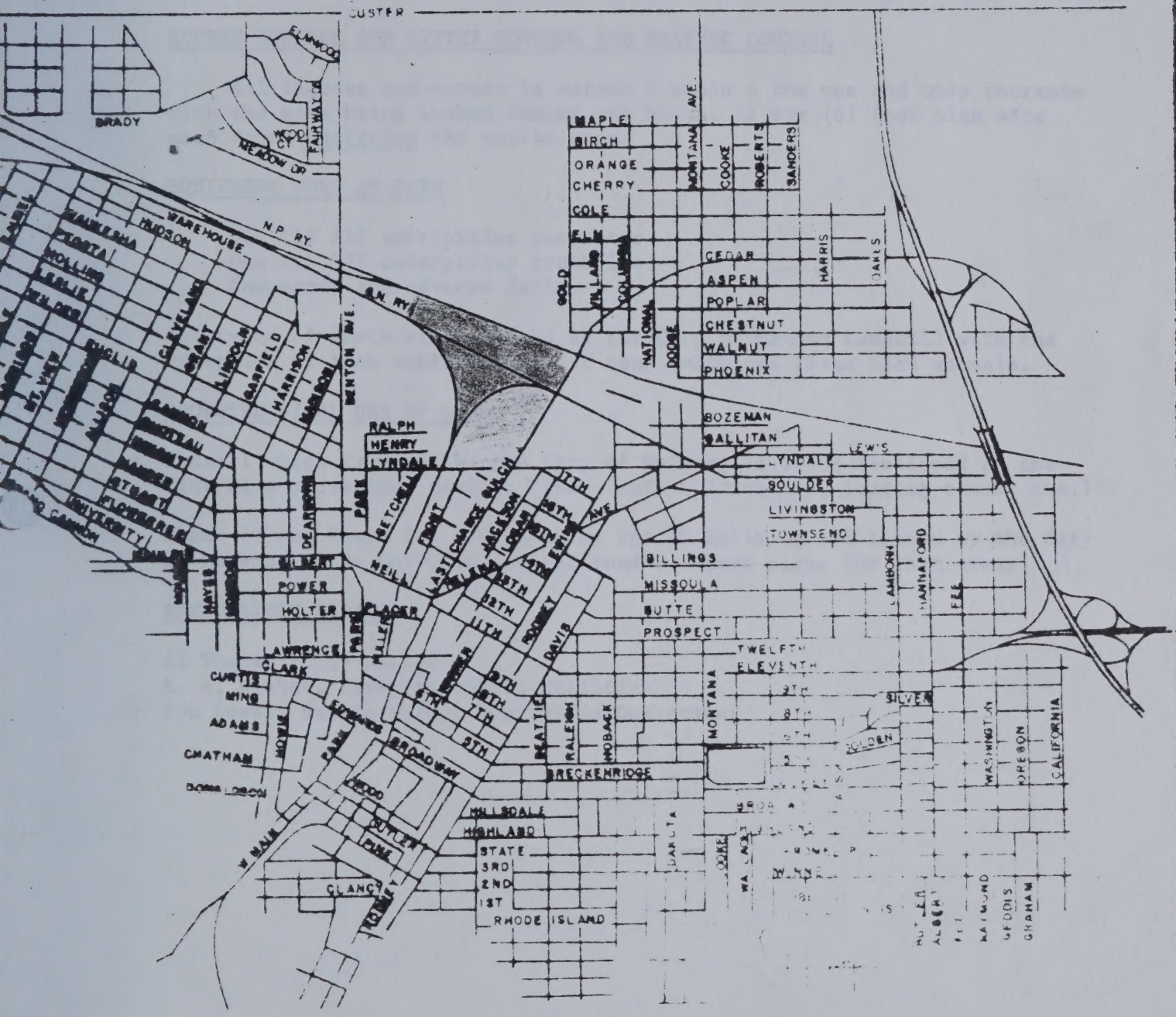
Distance from public or private water supplies: 1/4 mile

Are there springs located within one (1) mile of site? ( ) Yes (X) No

(If "yes", describe proximity to site): _____

HELENA

8/23/78



▨ — City of Helena Disposal Site



PROPOSED OPERATION & MAINTENANCE PLAN

DAYS AND HOURS SITE OPEN

Closed Sundays

Summer hours November - April 8 a.m. to 5 p.m. Monday - Saturday
Winter hours May - October 9 a.m. to 6 p.m. Monday - Friday 8-5 Sat.

ACCESS CONTROL AND LITTER CONTROL AND TRAFFIC CONTROL

All ingress and egress is across a scale a the one and only entrance with the gate being locked during off hours. A six (6) foot high wire mesh fence encircles the entire area.

EQUIPMENT USED AT SITE

One (1) 816 caterpillar compactor
One (1) 977 caterpillar track loader
Compacted and covered daily.

All types of waste are accepted at the City of Helena Landfill with the exception of junk vehicles, septic tank waste and large dead animals.

PROPOSED FINAL USE OF LAND

Phase I which is owned by the City of Helena, is being developed by the City as a recreation center. (Re: soft ball fields, jogging track, etc.)

Phase II and Phase III are owned by the BN Railroad and leased by the City of Helena. I do not know the railroad's future plans for that area.

RESPONSIBLE PERSONS

Al Thelen, City Manager
R. A. Nisbet, Director Public Utilities
Don Lewis, Suerintendent Sanitation Department

All that part of the right of way of the Burlington Nor Inc. Ramy Comp in the No East Quarter No west Quarter (NE½ NW½ and in the Northwest Quarter Nor East Quarter (NW½ NE½) of Sec 30, Township 10 North, Range 3 West of the Montana Principal Meridian, in the City of Helena, County of Lewis & Clark, State of Montana, located as shown in hatched red on the Exhibit, "A" attached to that certain Easement dated October 17, 1959 granted by Great No Ramy Comp.

Don Lewis
Helena Mt.

HELENA SOLID WASTES BETTERMENT PROJECT

ANNUAL REPORT

JULY 1970 - JUNE 1971

FOR

THE CITY OF HELENA

THOMAS, DEAN & HOSKINS INC.
ENGINEERS
GREAT FALLS - BOZEMAN, MONTANA

HELENA SOLID WASTES

BETTERMENT PROJECT

ANNUAL REPORT

JULY 1970 - JUNE 1971

FOR

THE CITY OF HELENA

THOMAS, DEAN & HOSKINS INC.

ENGINEERS

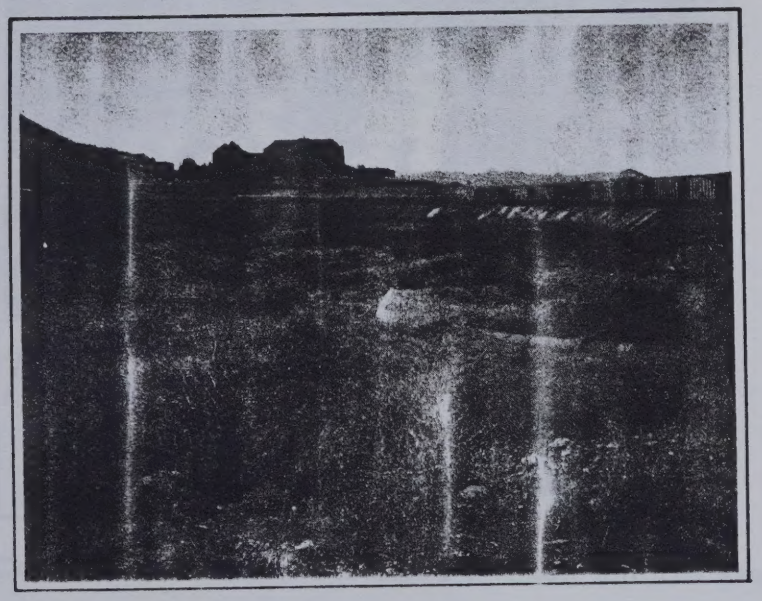
GREAT FALLS - BOZEMAN, MONTANA



LOCATION MAP



NEW SANITARY LANDFILL SITE



Looking west from northeast corner of new landfill site



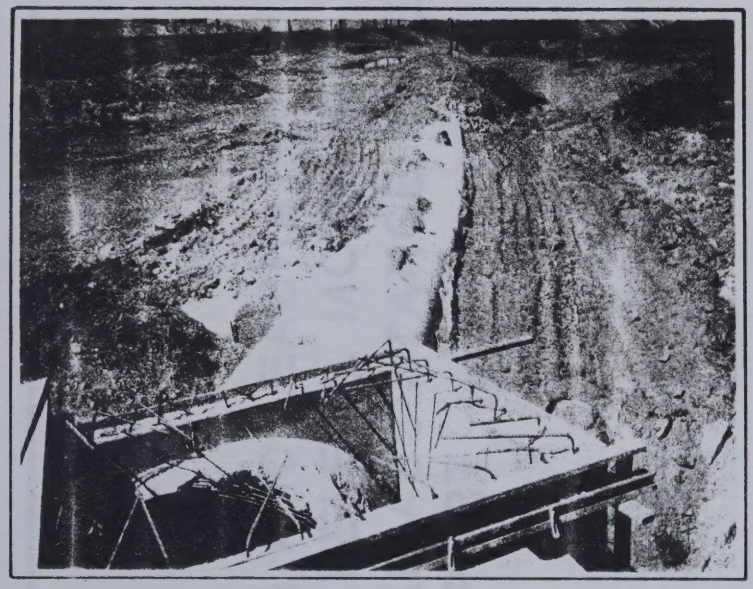
Looking north along centerline of new landfill site



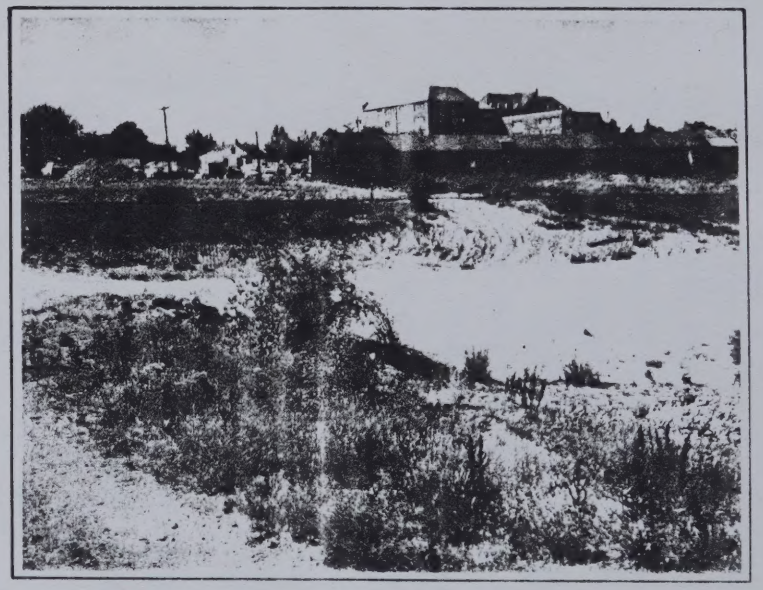
Looking west from northeast corner of new landfill with fill operation in process



Looking west from northeast corner of new landfill with cover soil over one lift of compacted refuse



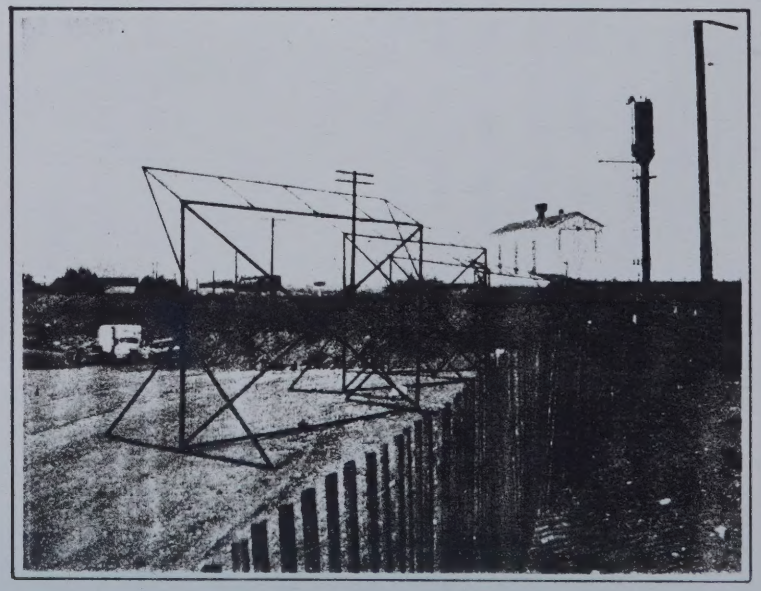
Concrete pipe drain installed through landfill site



Completed clay seal over drain pipe at landfill



New scalehouse and restroom facility at landfill



Portable fence units for controlling blowing papers at new landfill operation

United States Environmental Protection Agency

Region VIII
1860 Lincoln Street
Denver, Colorado 80295

July 1981
Report No.
908/6-81-002

Solid Waste

EPA

LANDFILL GAS AND LEACHATE MONITORING: HELENA, MONTANA - A TECHNICAL ASSISTANCE PANELS PROGRAM REPORT

III. STUDY AREA DESCRIPTION

Helena Landfill Site

The City of Helena landfill is situated northwest of the roadway intersection of Lyndale Avenue and Last Chance Gulch Street in the central part of the city. The site is bounded on the west by a small ridge upon which Carroll College buildings are located and on the north by the Burlington Northern Railroad tracks. The site is owned by the Burlington Northern Railroad and is leased to the City. Figure 5 depicts a layout of the site.

The landfill is situated within the alluvial valley of Last Chance Gulch, an intermittent stream which flows through the center of Helena. Last Chance Gulch has been diverted through a 60-inch concrete conduit beneath the present landfill. Water flows both in the conduit and in the bedding material upon which the conduit rests. The conduit presently discharges at the northwestern border of the landfill.

The City of Helena has indicated that other utility lines transect the landfill, including a sanitary sewer which crosses the property from the southwest to the northeast. It appears that this sewer line is below the existing landfill and that service lines from this sewer extend to the YMCA and National Guard Armory buildings on the eastern edge of the landfill.

The Helena landfill site is best described by dividing it into three distinct areas:

(1) **Inactive Fill Area:** The 17-acre inactive fill area, which encompasses the old burning dump, is located north of Lyndale Avenue, west of Last Chance Gulch Street and east of the north-south railroad spur. When sanitary landfilling practices were implemented in 1970, twelve acres of the original 17 acre burning dump were filled with wastes. A National Guard Armory and a Y.M.C.A. have been built on the remaining acreage of the old burning dump. The inactive fill area was completed in June, 1977.

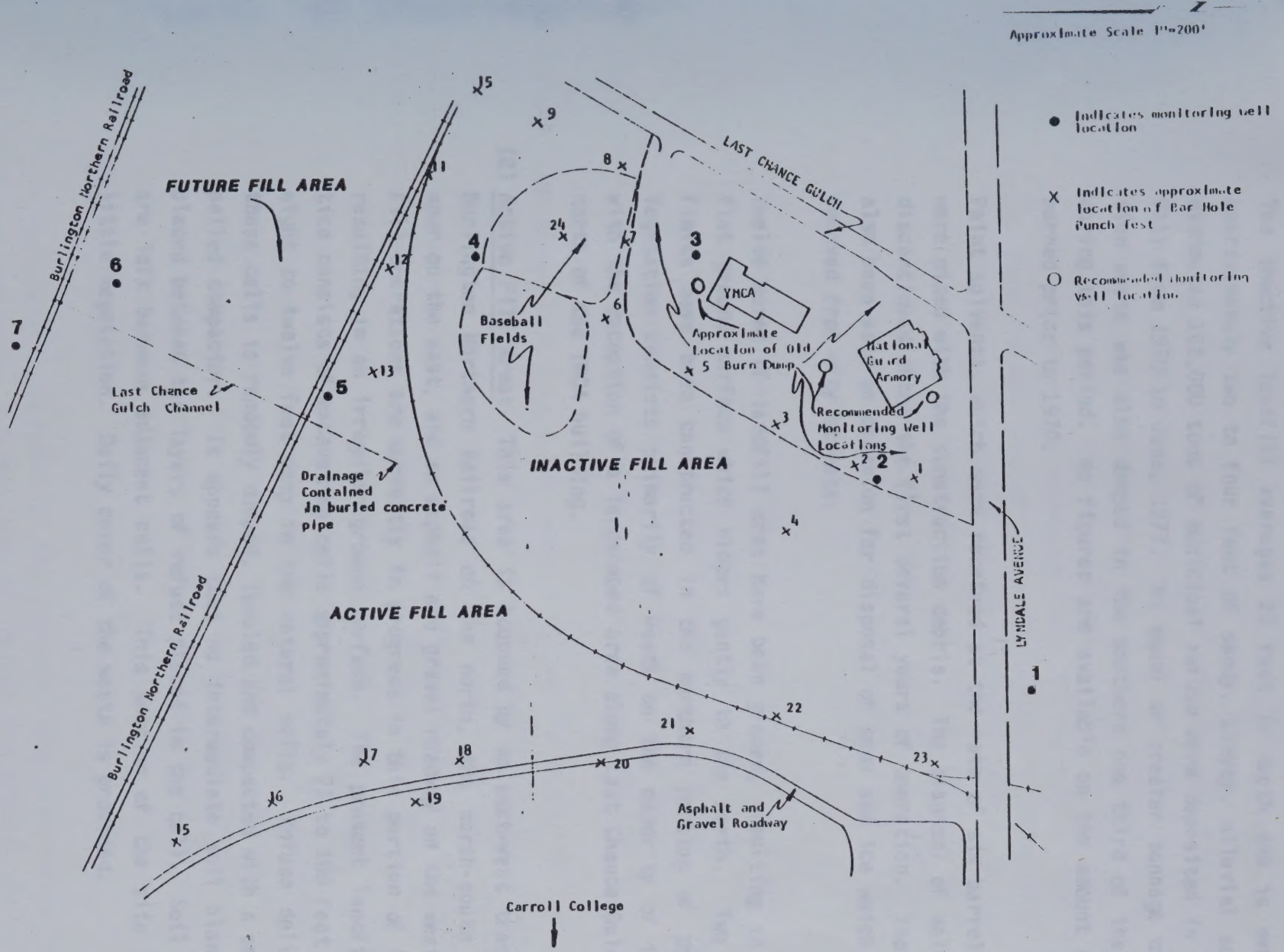


FIGURE 5. THE HELENA LANDFILL SITE SHOWING BARHOLE PUNCH TEST AND MONITORING WELL LOCATIONS



The inactive landfill averages 25 feet in depth and is overlain by approximately two to four feet of sandy, clayey, alluvial soils. An estimated 162,000 tons of municipal refuse were deposited in the landfill from 1970 to June, 1977. An equal or greater tonnage of demolition waste was also dumped in the southern one third of the landfill during this period. No figures are available on the amount of wastes burned prior to 1970.

Paint solvents, which were received at the rate of six barrels a week, were mixed with the construction debris. The disposal of solvents was discontinued after the first several years of operation. The site has also been used on occasion for disposal of snow and ice which had been removed from city streets.

Twelve acres of landfill area have been graded, resulting in a fairly flat ground surface which slopes gently to the north. Two baseball fields have been constructed in the northern portion of this area. Vegetation consists primarily of weeds on the majority of this site with the exception of a landscaped area along Last Chance Gulch Street north of the YMCA building.

(2) **Active Fill Area:** This area is bounded by an east-west track of the Burlington Northern Railroad on the north, the north-south railroad spur on the east, and an asphalt and gravel roadway on the west. Landfill operations are currently in progress in this portion of the site, resulting in an irregular ground surface. The present landfill practice consists of excavating cells approximately 75 to 100 feet wide and eight to twelve feet deep in the natural soils. Refuse delivered to these cells is randomly dumped, leveled and compacted with a self- propelled compactor. It appears that no intermediate soil blankets are placed between the layers of refuse placed in the cell. Soil barriers are left between adjacent cells. This portion of the site has very little vegetation. Daily cover of the waste is provided.

Access to the site is limited to six days per week, Monday through Saturday. The site has a gatehouse with scales and all vehicles are weighed to determine the quantity of waste received at the site. Approximately 30,000 tons of waste are received at the site annually and it is estimated that in January 1982, the expected closing date of this portion, 159,000 tons of municipal refuse will have been deposited. The majority of these wastes are generated within the city limits of Helena. No user fee is assessed to city residents; rather, an annual collection assessment is charged. Citizens or commercial establishments which are not assessed collection fees must pay a user fee at the gate.

Four persons are employed at the landfill - a gate keeper, two equipment operators, and a laborer. The site is maintained primarily by a bulldozer and a landfill compactor. A scraper is also available for excavating trenches and stockpiling cover material. The landfill is in full compliance with all local, State, and Federal standards.

(3) **Future Fill Area:** The future fill area is located west of Last Chance Gulch Street and between the two east-west Burlington Northern Railroad tracks. This area is expected to have an 18-year life beginning in January, 1982 with an average annual waste load of 35,000 tons per year. It is approximately 20 to 25 feet lower than the landfill mass to the south. The ground surface slopes gently down to the north with a maximum difference in elevation on the order of 5 to 10 feet. In this area, Last Chance Gulch leaves the 60-concrete conduit beneath the landfill, and returns to its natural channel. The channel had a moderate amount of flow at the time of the study. Vegetation consists of grasses, weeds and numerous deciduous trees along the drainage way.

Landfill Site Geology

An independent assessment of the geological and geotechnical data associated with the Helena landfill site was beyond the scope of this study. Site geology information, which follows, was obtained from a memo prepared by Mr. Kenneth L. Waesche, geologist for the State of Colorado Department of Health

approximately a 20 acre parcel in the N 1/2 of the NW 1/4 Section 30, Township 10, Range 3.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. Box 970, Bozeman, Montana 59715

RECEIVED
SEP 20 1976
CITY of HELENA
ENGINEER

SUBJECT: EVT--Pollution and Waste Management Report
Helena Sanitary Landfill Expansion site Evaluation
Sec. 19 & 30, T10N, R3W

DATE: 9/9/76

TO: Arnold E. Quale
District Conservationist
Soil Conservation Service
Helena, Montana

As requested by the city of Helena, an investigation and evaluation of their proposed sanitary landfill expansion was made during August, 1976. Don Coffman, Ground Water Hydrologist, USGS, Helena, was consulted.

The site should not be used for the disposal of Group I (toxic, etc.) wastes. The site is considered suitable for Group II wastes if ground water separation is maintained and surface water control measures are taken as recommended. There is a low pollution potential to surface waters and a moderate pollution potential to several nearby wells. These wells are not critical supplies and could be converted to city water service.

Water passing through buried refuse leaches out contiminants. This "leachate" may drastically alter the quality of surface and ground waters. Sanitary landfill siting and operations should minimize the amount of water that can reach the refuse and should provide for the control or attenuation of any leachate produced.

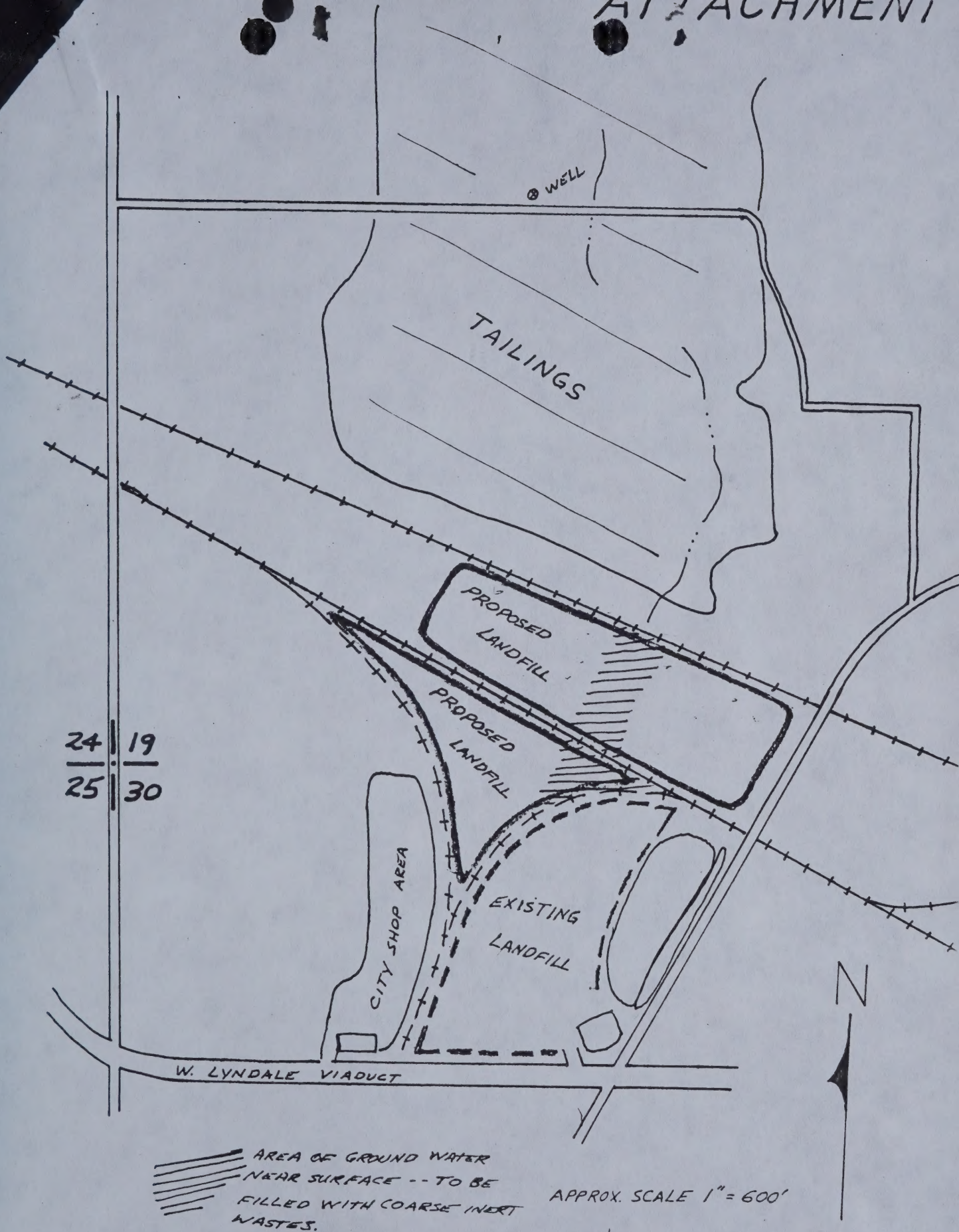
Site Evaluation

The existing landfill is located on the lower end of Last Chance Gulch where it begins to merge with the Helena Valley. The proposed expansion area is adjacent, north and north-northeast of the existing landfill. See Sketch Attachment 1.

Geology: Stratigraphically the site is underlain by the Helena Limestone of Precambrian Age. The Helena Limestone is predominately a gray, argillaceous limestone which weathers to a light brown or yellow. Locally, the limestone is very dolomitic. The limestone or dolomite can be seen outcropping in several roadcuts above the landfill.

Overlying the Helena Limestone are thick deposits of alluvial-colluvial origin. These materials have been deposited at the mouth of Last Chance Gulch as fan debris and stream depositing alluvium. These coarser deposits of sand, gravel, and cobbles have been dredged at sometime in the past for the gold they contained. Apparently the dredging operation went down to a clay lens which carried the gold. The resulting tailings

ATTACHMENT



SKETCH - HELENA SANITARY LANDFILL

